

*Mark ... Isuzu genuine lubricants

SECTION 2

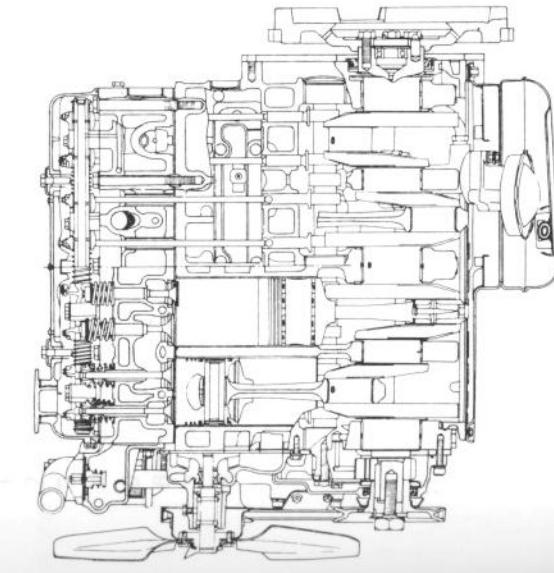
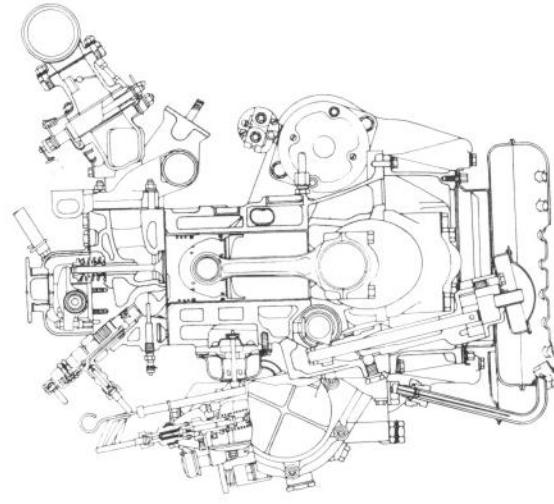
ENGINE ASSEMBLY

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GENERAL DESCRIPTION

C190 C240 models

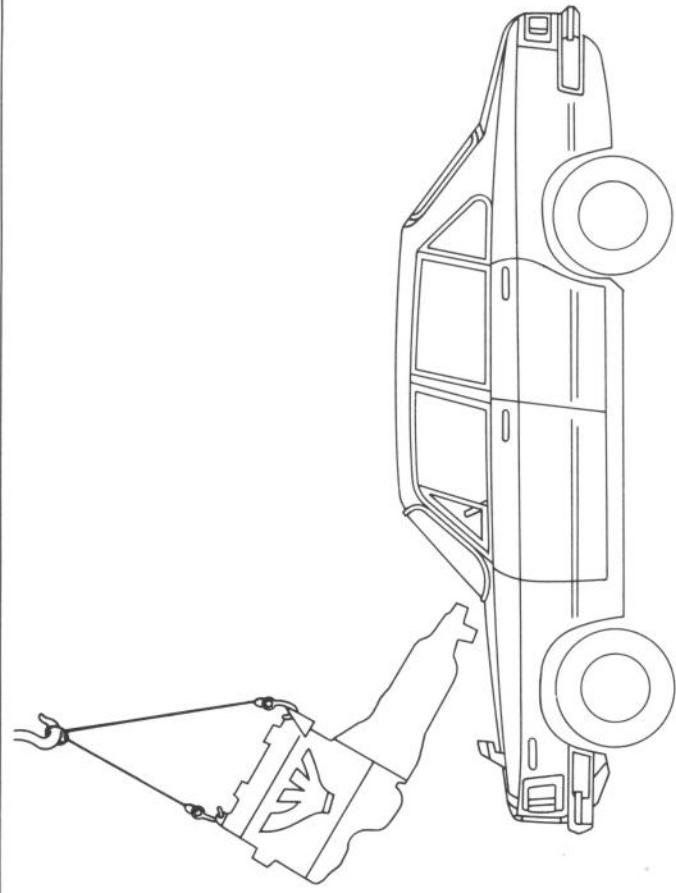




REMOVAL AND INSTALLATION

This section deals only with major service operations and major component parts removal and installation.

PASSENGER CAR



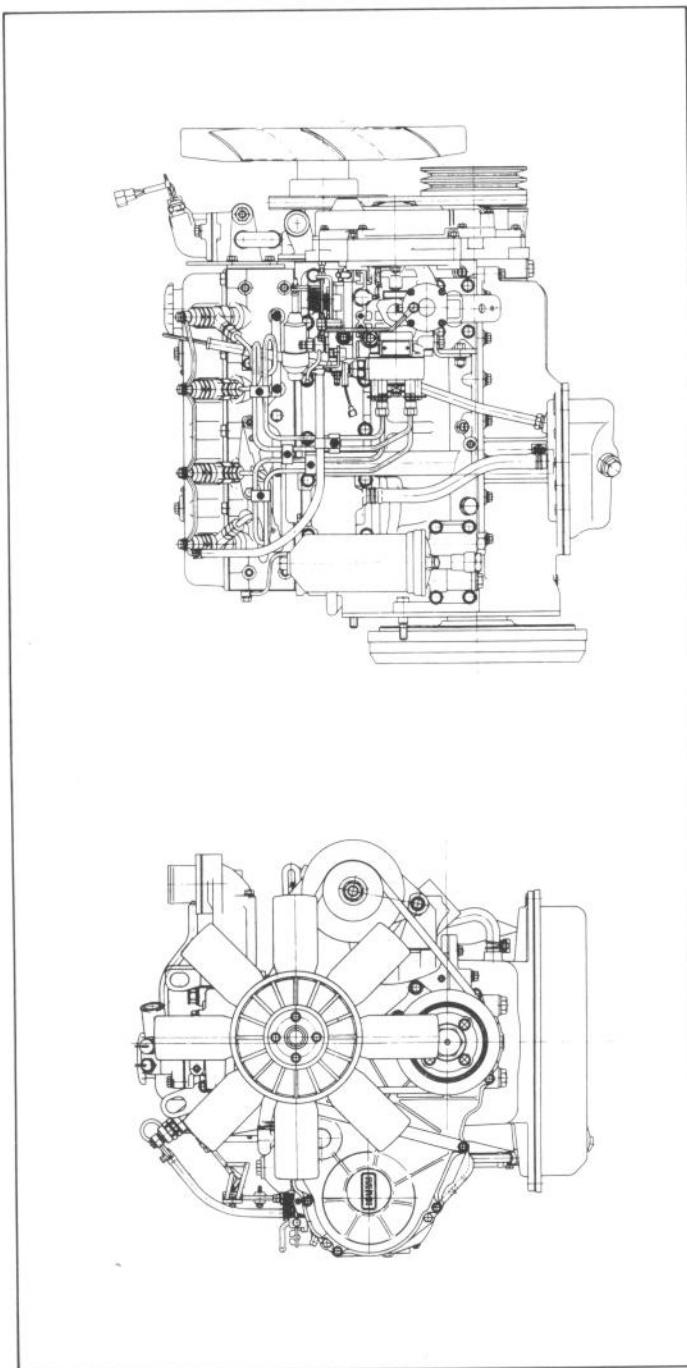
0K934

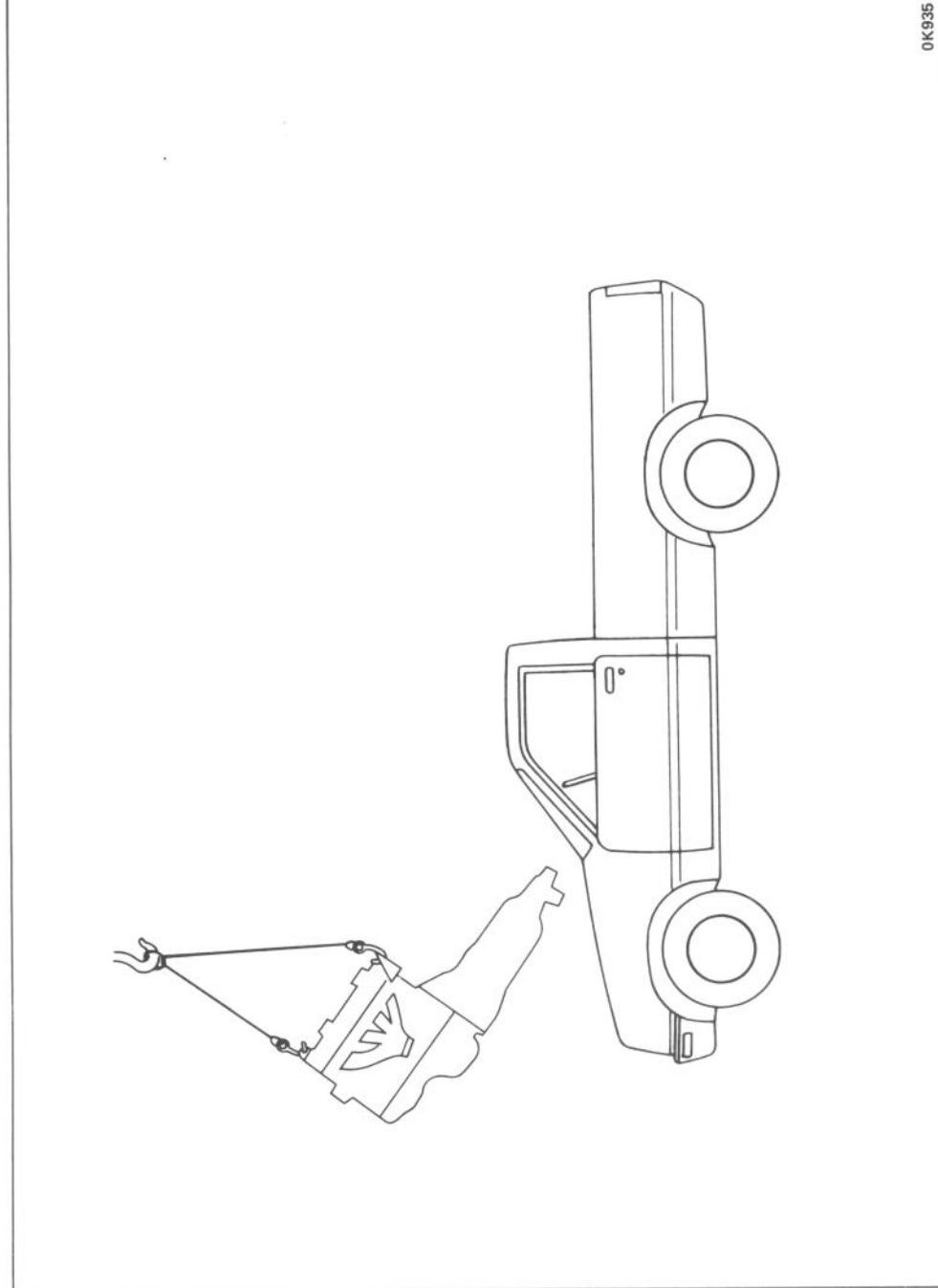
Installation steps

To install, follow the removal procedure in reverse order.

Removal steps

1. Battery cable
2. Engine hood
3. Fan and fan shroud
4. Exhaust pipe
5. Gearshift lever
6. Clutch cable
7. Propeller shaft
8. Engine

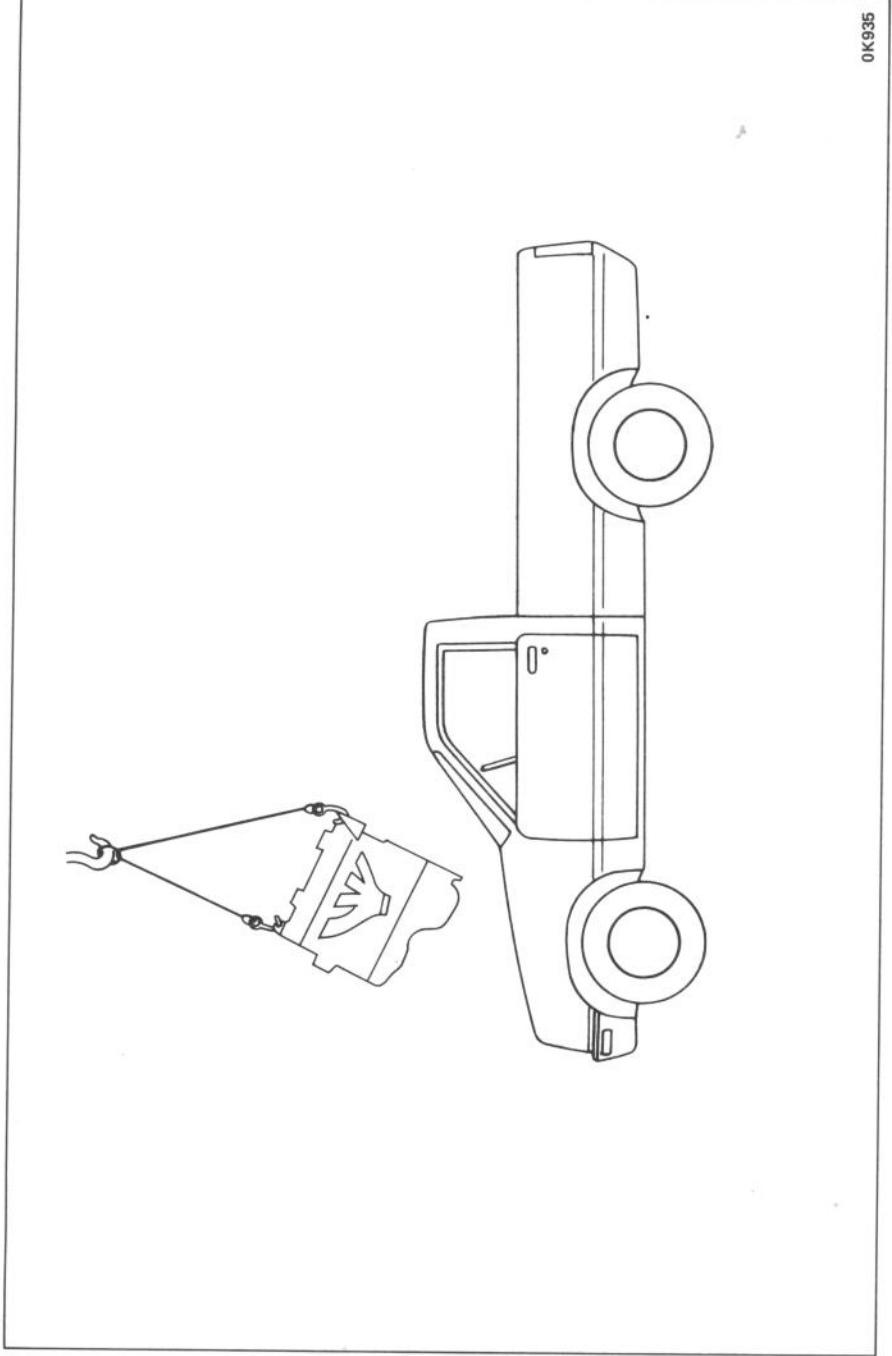


LIGHT-DUTY-TRUCK (KBD 4 x 2 model)**Removal steps**

1. Battery
2. Engine hood
3. Fan and fan shroud
4. Exhaust pipe
5. Gearshift lever
6. Clutch cable
7. Propeller-shaft
8. Engine with transmission

Installation steps

To install, follow the removal procedure in reverse order.

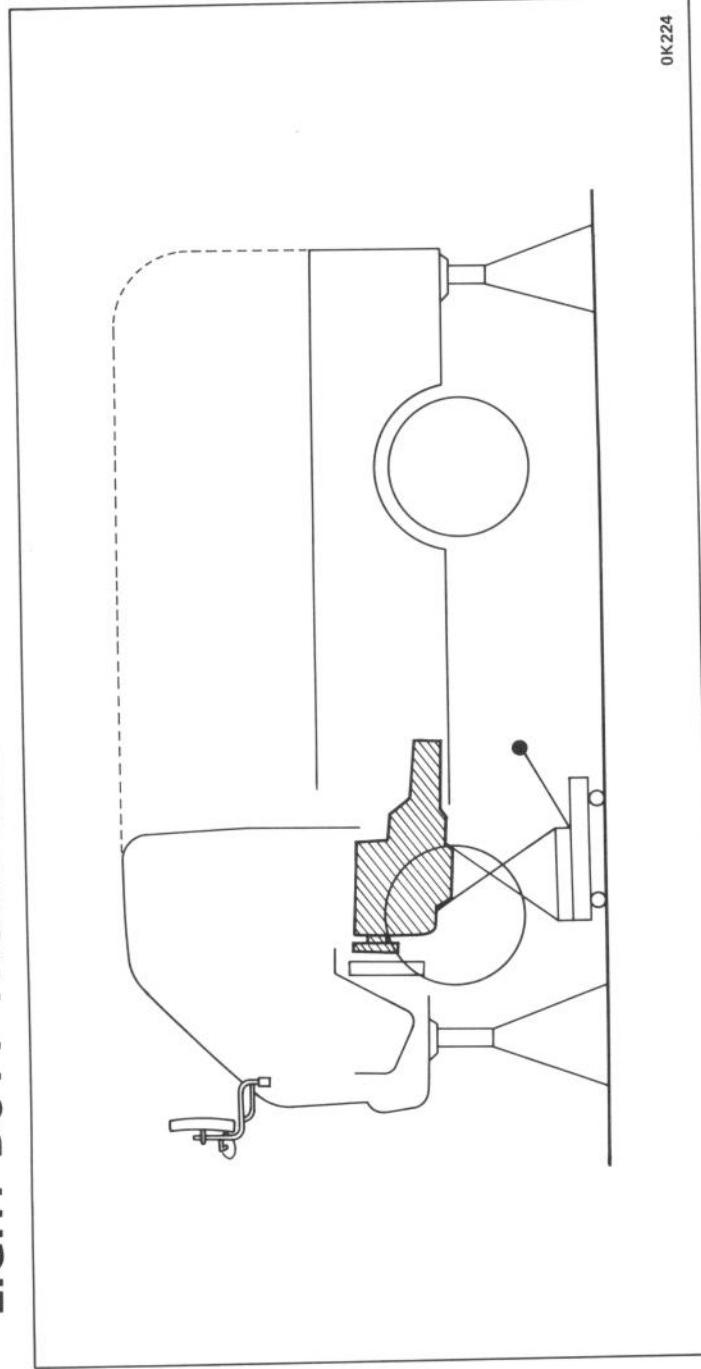
LIGHT DUTY-TRUCK (KBD 4 x 4 model)**Removal steps**

1. Battery cable
2. Engine hood
3. Fan and fan shroud
4. Exhaust pipe
5. Gearshift lever
6. Quadrand box
7. Clutch cable
8. Propeller shaft
9. Starter motor
10. Transmission rear mounting and bracket
11. Transfer side case
12. Transmission
13. Engine

Installation steps

To install, follow the removal procedure in reverse order.

LIGHT-DUTY-TRUCK AND BUS (KAD and TLD models)



Removal steps

- ▲ 1. Battery cable and electrical cable
- ▲ 2. Engine cover
- ▲ 3. Radiator hose and heater hose
- ▲ 4. Intake pipe vacuum hose and fuel pipe
- 5. Engine control cable
- 6. Exhaust pipe
- 7. Tie rod
- 8. Transmission control rod
- 9. Clutch slave cylinder
- 10. Speedometer cable
- 11. Parking brake cable
- 12. Propeller shaft
- 13. Exhaust pipe bracket
- ▲ 14. Engine foot bracket
- 15. Transmission mount bracket
- ▲ 16. Engine with transmission
- 17. Engine

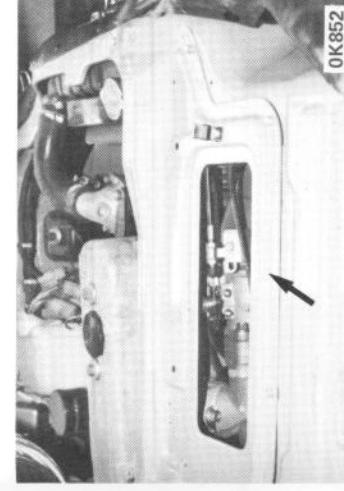
Installation steps

- 1. Engine
- ▲ 2. Engine with transmission
- ▲ 3. Transmission mount bracket
- ▲ 4. Engine foot bracket
- ▲ 5. Exhaust pipe bracket
- ▲ 6. Propeller shaft
- 7. Parking brake cable
- 8. Speedometer cable
- 9. Clutch slave cylinder
- 10. Transmission control rod
- ▲ 11. Tie rod
- ▲ 12. Exhaust pipe
- 13. Engine control cable
- 14. Intake pipe, vacuum hose and fuel pipe
- 15. Radiator hose and heater hose
- 16. Engine cover
- 17. Battery cable and electrical cable

Important operations — Removal

1. Battery cable and electrical cable

Disconnect the cables.



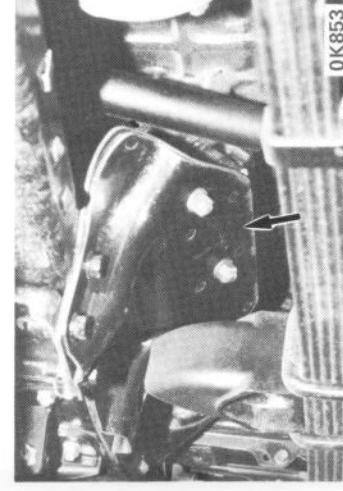
2. Engine cover
1. Raise the companion's seat.
2. Remove the driver seat cushion, then remove the engine cover.

3. Radiator hose and heater hose

When the engine and radiator are filled with long life coolant drain and keep the coolant in a clean container.

14. Engine foot bracket

Support the engine on a transmission jack.



16. Engine with transmission

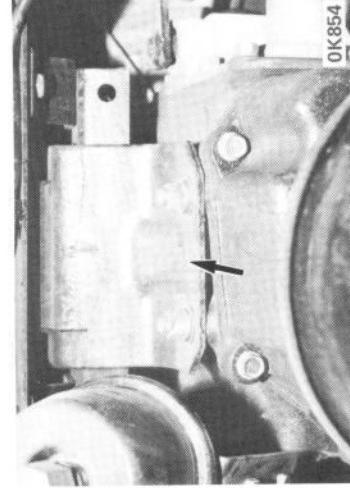
Removal of transmission assembly and clutch.

Refer to transmission and clutch workshop manuals for removal procedure.

 **Important operations — Installation**

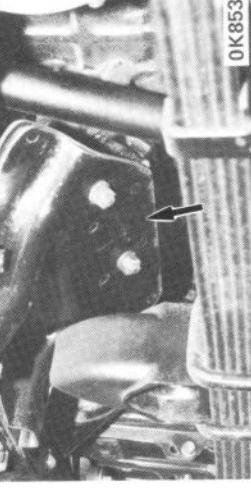
 **3. Transmission mount bracket**

Torque	(kg-m)	2.8 — 4.7
--------	--------	-----------



Torque	(kg-m)	2.8 — 4.7
--------	--------	-----------

Torque	(kg-m)	2.8 — 4.7
--------	--------	-----------

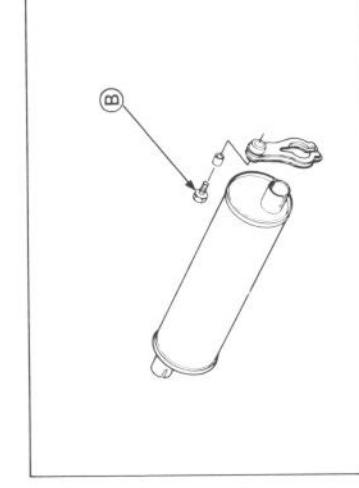


 **4. Engine foot bracket**

Torque	(kg-m)	2.8 — 4.7
--------	--------	-----------

 **5. Exhaust pipe bracket**

Torque	(kg-m)	1.7
--------	--------	-----



 **6. Propeller shaft**

Torque	(kg-m)	4 — 6
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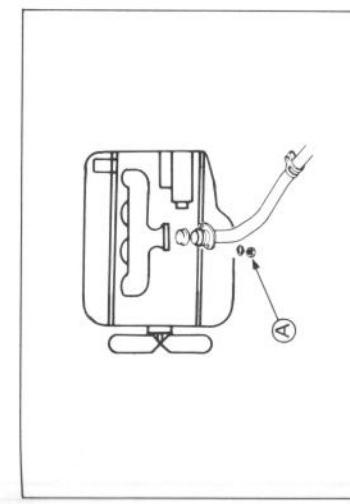
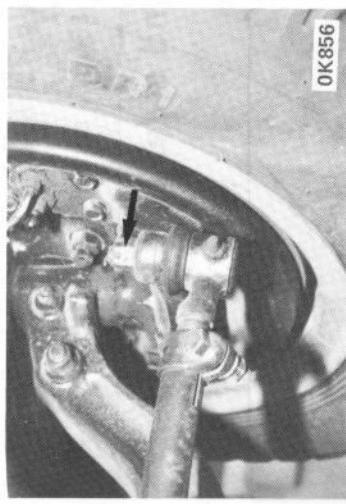


11. Tie rod

Torque	(kg-m)	6 — 9
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12. Exhaust pipe

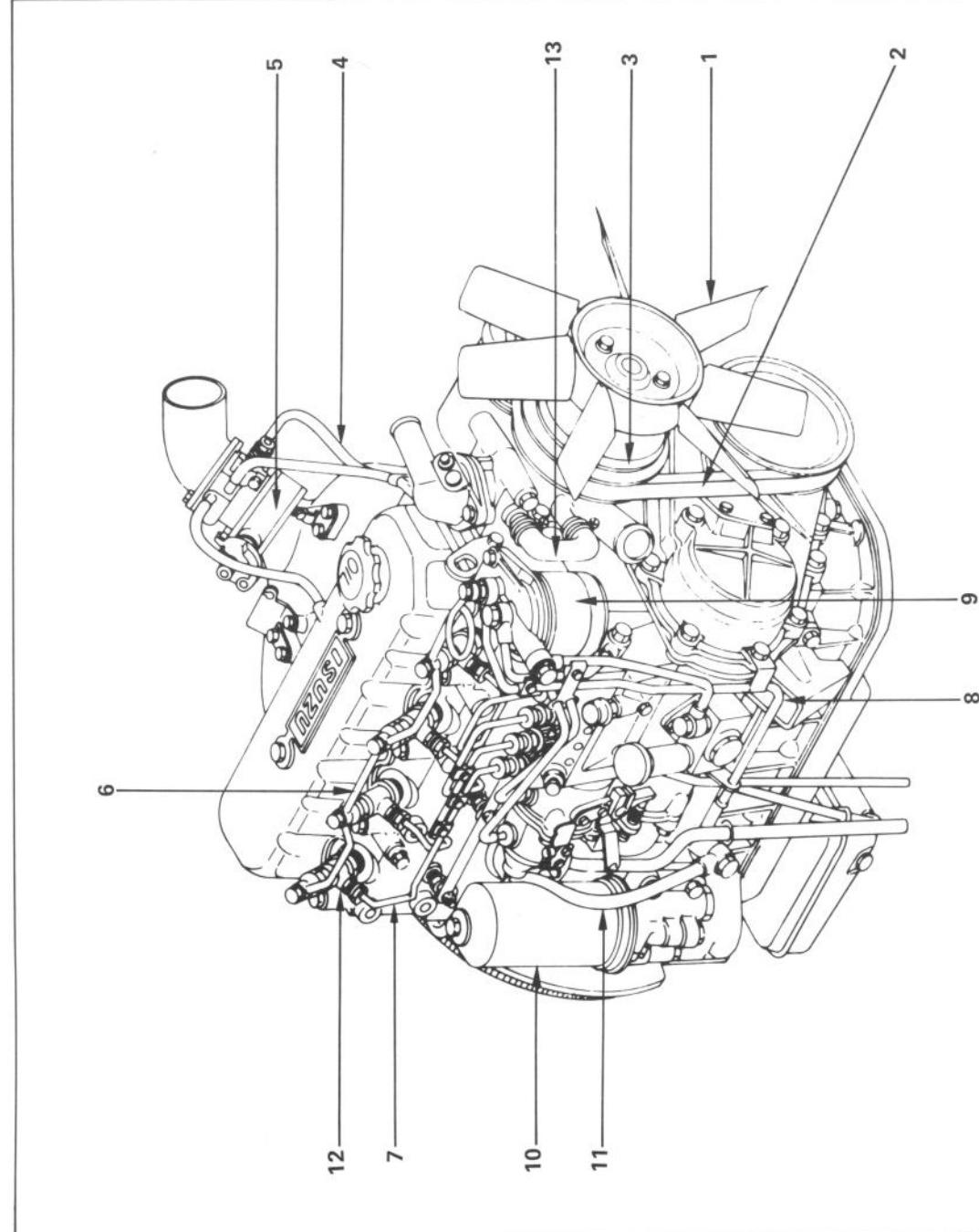
Torque	(kg-m)	3.8
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DISASSEMBLY

EXTERNAL PARTS (Right hand side) I

This illustration is based on the C240 model.

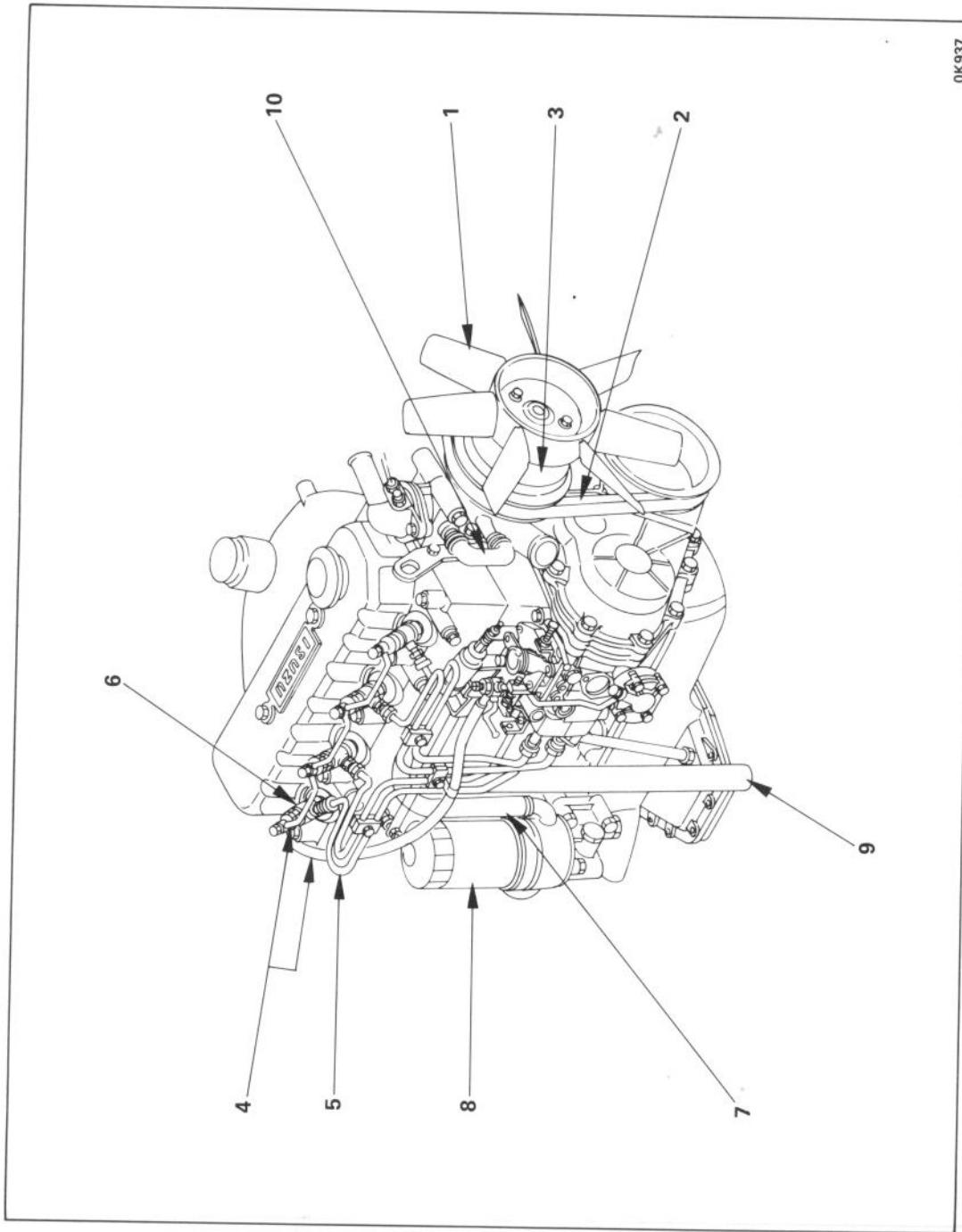


Disassembly steps

1. Cooling fan
2. Fan belt
3. Fan pulley
4. Vacuum hose
5. Intake shutter and throttle valve
6. Leak off pipe
7. Water hose
8. Fuel pipe
9. Fuel filter
10. Oil filter
11. Oil pipe : Oil gallery to vacuum pump
12. Injection nozzle
13. Water hose

EXTERNAL PARTS (Right hand side) II

This illustration is based on the C190GB model.



Disassembly steps

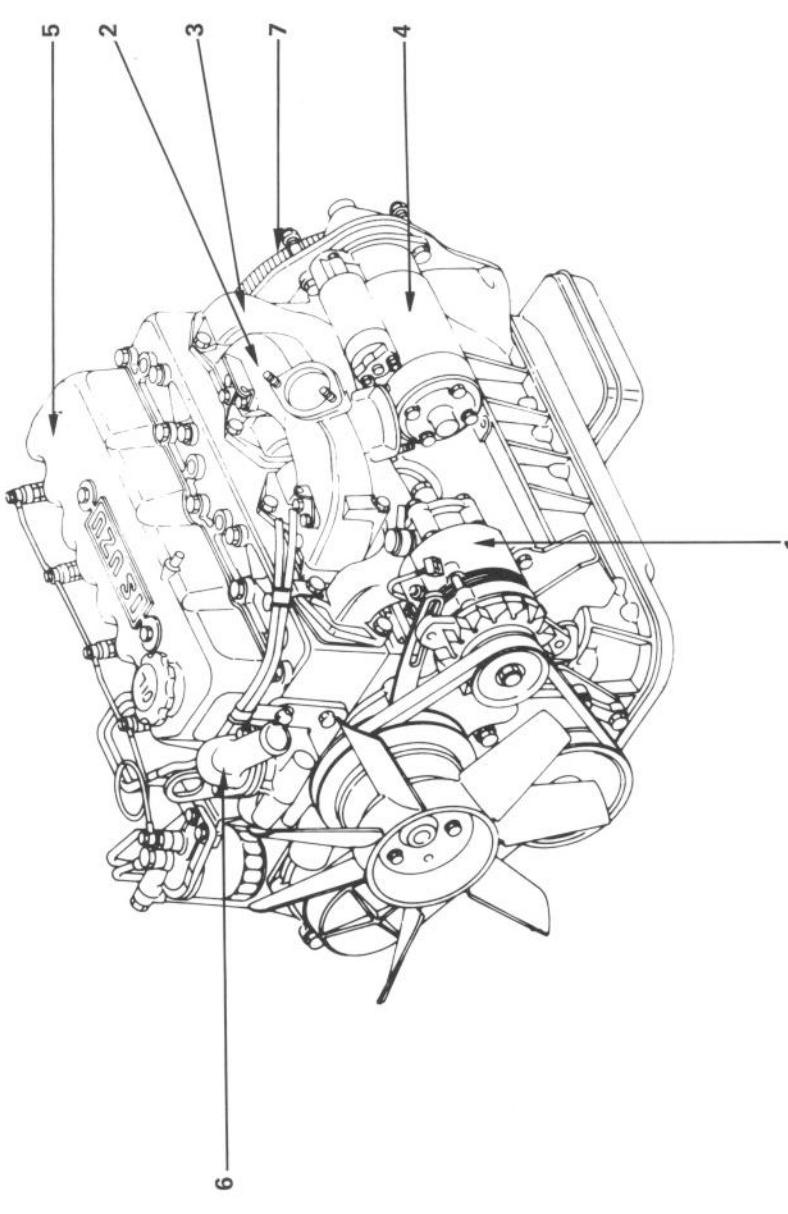
1. Cooling fan and spacer
2. Fan belt
3. Fan pulley
4. Leak off pipe
5. Injection pipe
6. Injection nozzle
7. Water hose
8. Oil filter assembly
9. Air breather hose
10. Water hose

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EXTERNAL PARTS (Left hand side)**MAJOR COMPONENTS**

Gear drive type



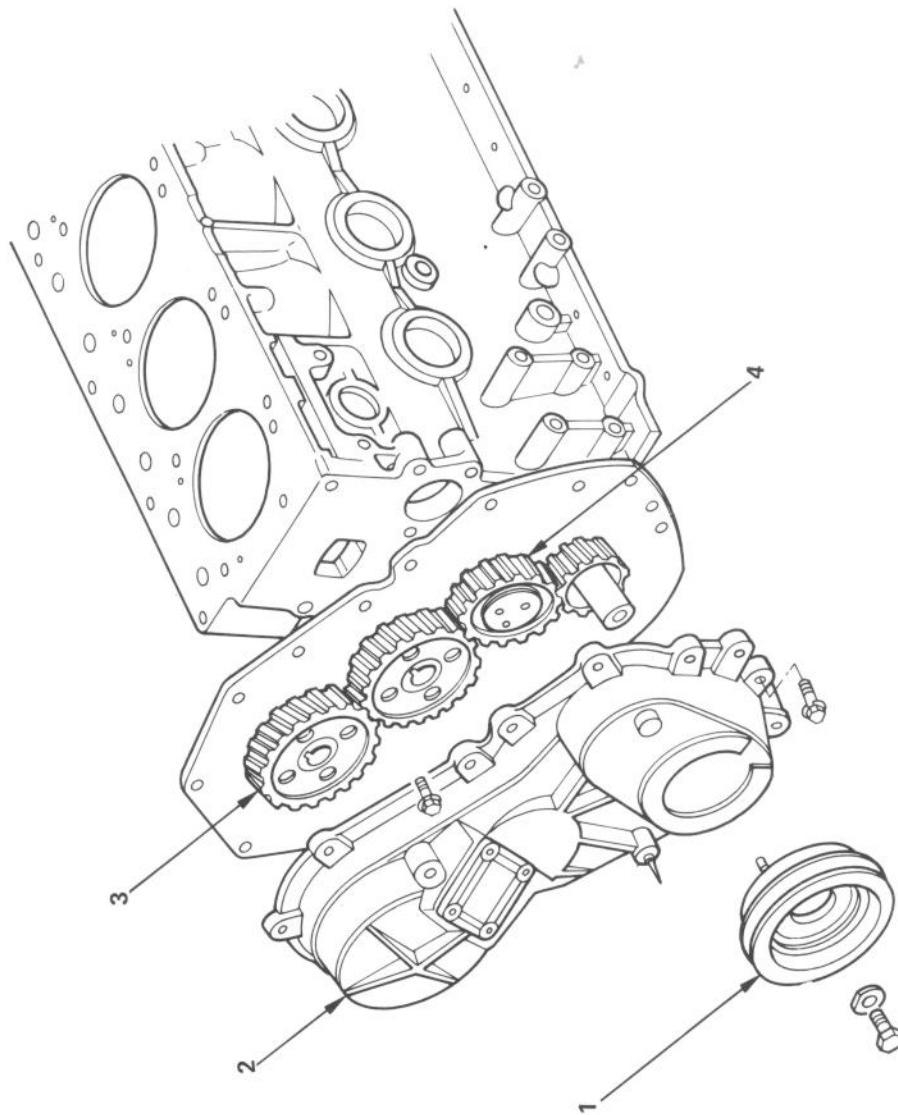
OK938

Disassembly steps

1. Generator assembly
2. Intake manifold
3. Exhaust manifold
4. Starter motor
5. Head cover
6. Thermostat housing
7. Flywheel

INTERNAL PARTS (Timing gear train)**MAJOR COMPONENTS**

Gear drive type



OK939

Disassembly steps

1. Pulley
2. Timing gear case cover
3. Injection pump gear
4. Idler gear

INTERNAL PARTS (Timing gear train)

MAJOR COMPONENTS

Important operations

3. Injection pump assembly

Inspect the following items before timing gear removal.
Backlash (crankshaft gear, idler gear, camshaft gear, injection pump gear).

	Standard	Limit	(mm)
	0.10 – 0.17	0.3	

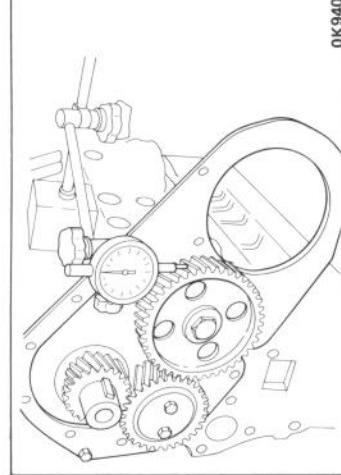
4. Idler gear end play

	Standard	Limit	(mm)
	0.07	0.2	

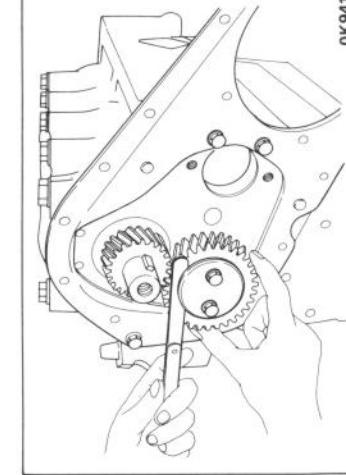


3. Injection pump assembly

Inspect the following items before timing gear removal.
Backlash (crankshaft gear, idler gear, camshaft gear, injection pump gear).



4. Idler gear end play



Belt drive type

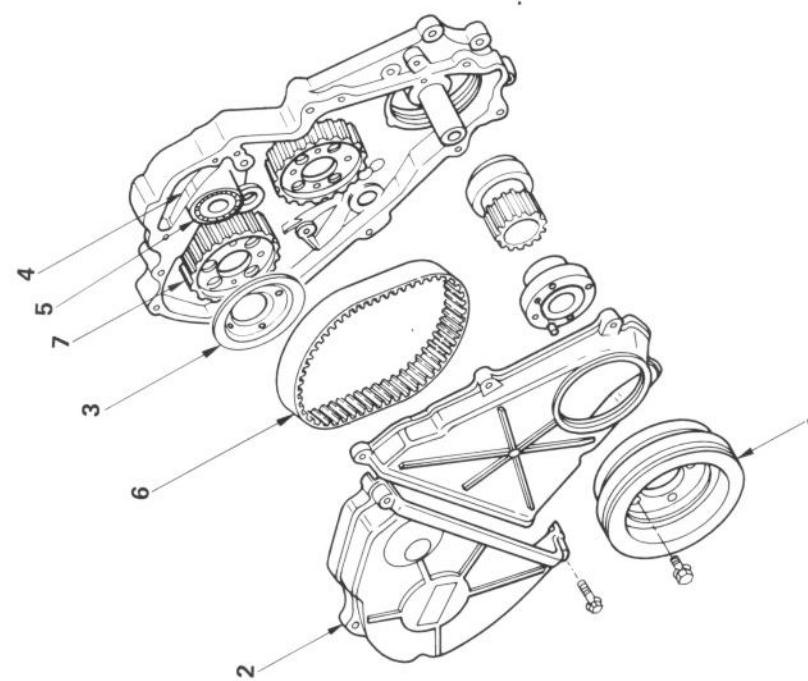
Inspect the following items before timing gear removal.
Backlash (crankshaft gear, idler gear, camshaft gear, injection pump gear).

	Standard	Limit	(mm)
	0.10 – 0.17	0.3	

	Standard	Limit	(mm)
	0.07	0.2	

7. Injection pump gear

Remove the injection pump front bracket and rear bracket.



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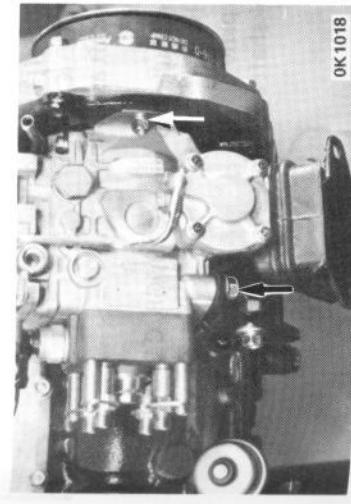
Disassembly steps

1. Pulley
2. Pulley housing cover
3. Injection pump timing pulley flange
4. Tension spring
5. Tension bearing and center
6. Timing belt
- ▲ 7. Injection pump gear



Important operation

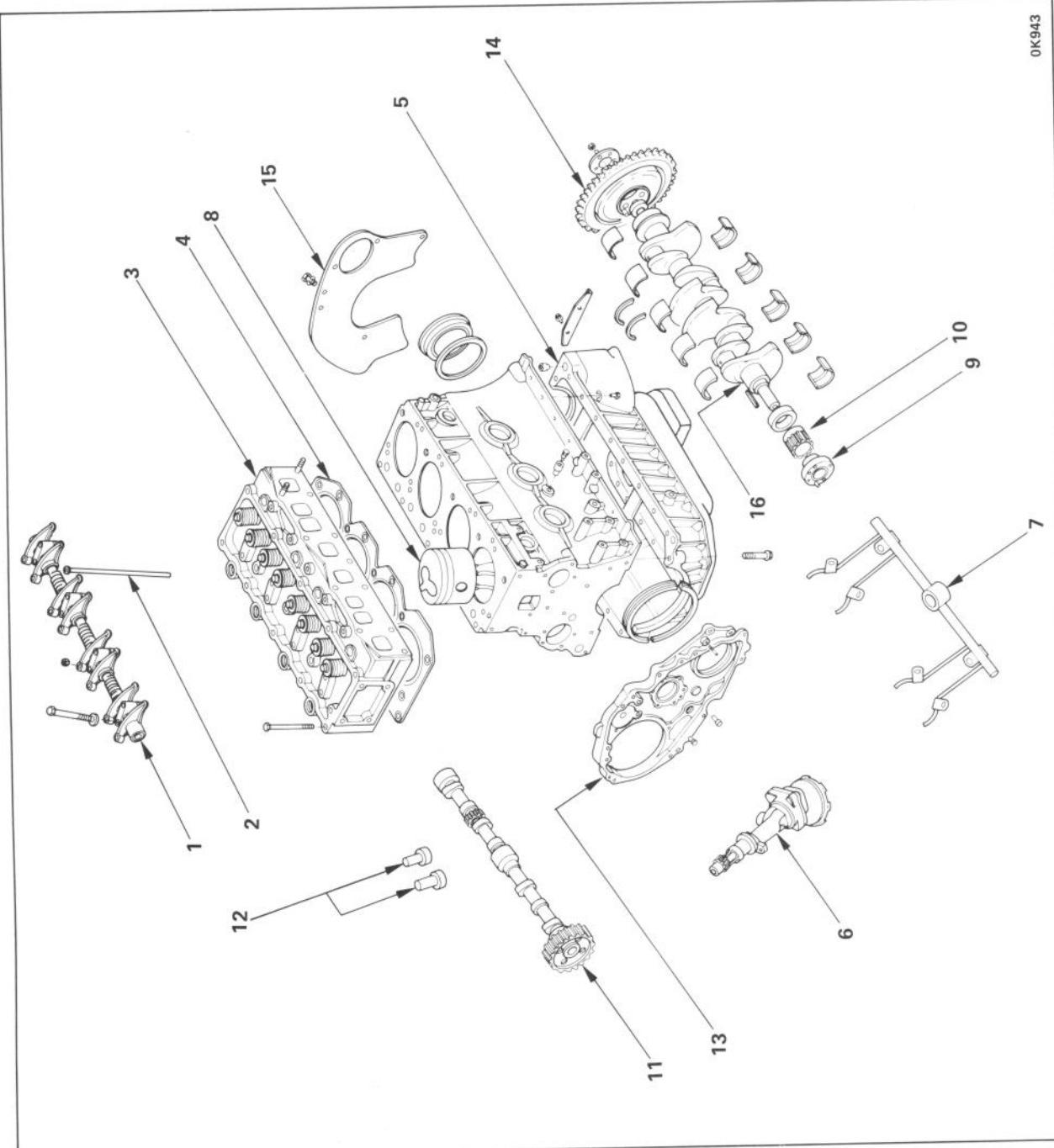
7. Injection pump gear
- Remove the injection pump front bracket and rear bracket.



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INTERNAL PARTS

MAJOR COMPONENTS

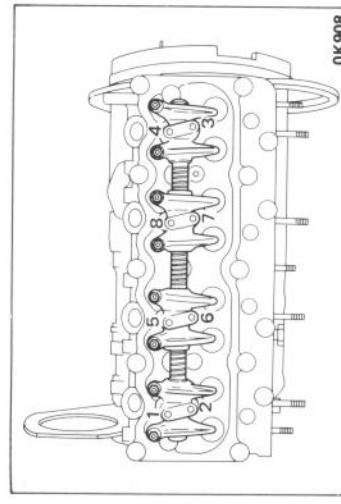


Disassembly steps

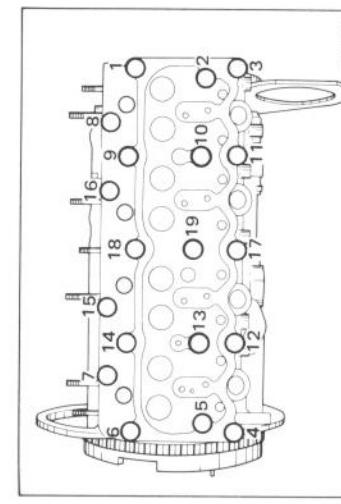
- | | |
|--|---|
| ▲ 1. Rocker arm bracket and shaft | ▲ 10. Crankshaft timing pulley (C190GB, C190KE) |
| 2. Push-rod | ▲ 11. Camshaft assembly |
| 3. Cylinder head | 12. Tappet |
| 4. Cylinder head gasket | 13. Timing pulley housing (C190GB, C190KE) |
| 5. Crankcase | 14. Flywheel |
| 6. Oil pump | 15. Rear plate |
| 7. Oiling jet | ▲ 16. Crankshaft assembly |
| 8. Piston | |
| 9. Crankshaft pulley center (C190GB, C190KE) | |

! Important operations

1. **Rocker arm bracket and shaft**
Loosen rocker arm shaft bracket bolts in numerical order.

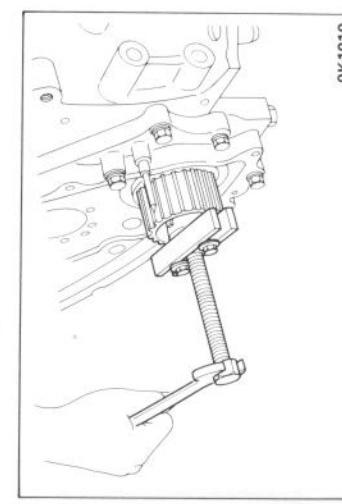


3. **Cylinder head**
Loosen cylinder head bolts in numerical order.

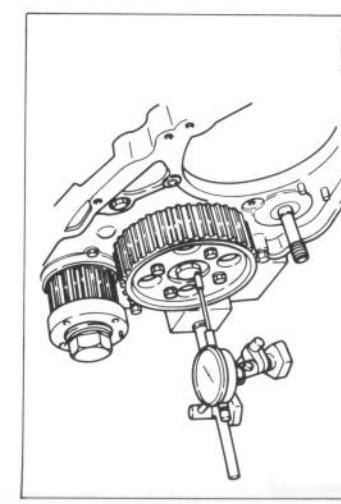


10. **Crankshaft timing pulley (C190GB, C190KE)**

Remover : 5-85210-016-0



11. **Crankshaft end play (C190GB, C190KE)**



Standard	Limit
0.08	0.2

(mm)

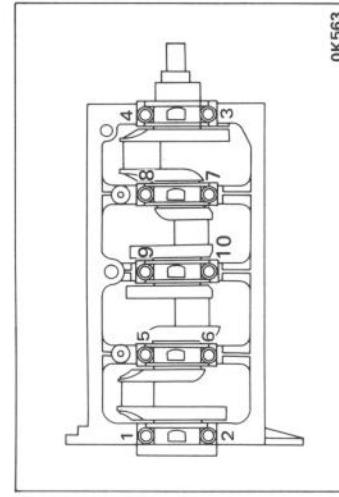
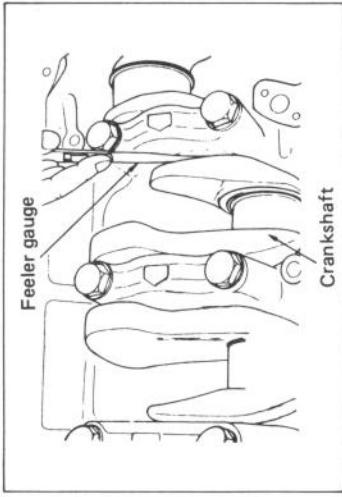
16. Crankshaft assembly

Check the crankshaft end play before disassembly.



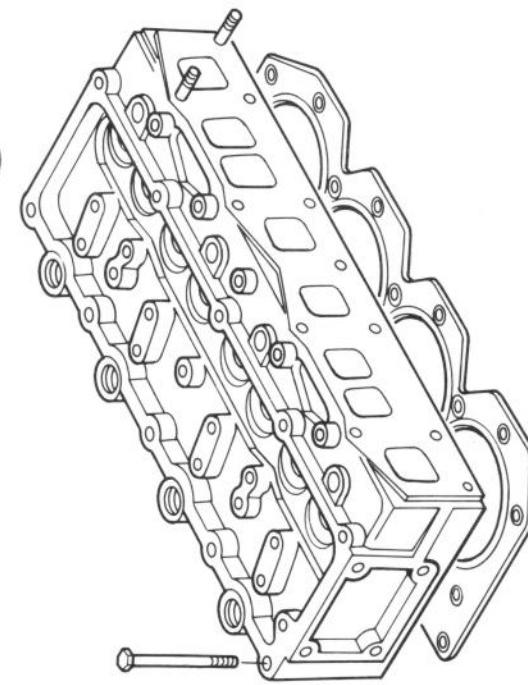
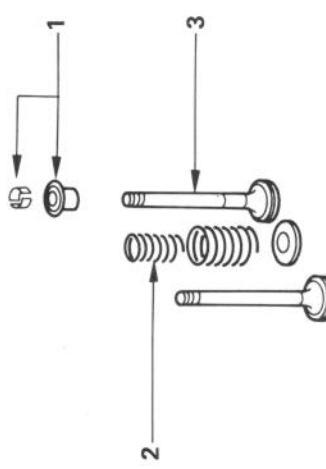
	Standard	Limit	(mm)
	0.1	0.3	

Crankshaft bearing cap bolts.
Loosen bearing cap bolts in numerical order.



MINOR COMPONENTS

CYLINDER HEAD



0K945

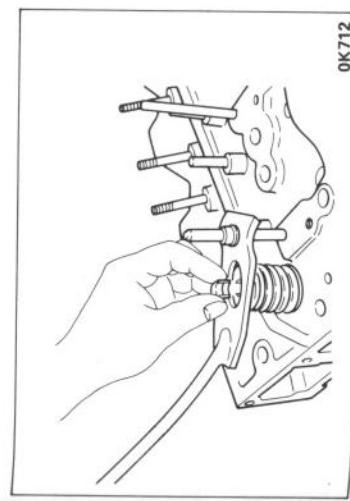
Disassembly steps

- ▲ 1. Spring seat and split key
- 2. Valve spring
- 3. Valve



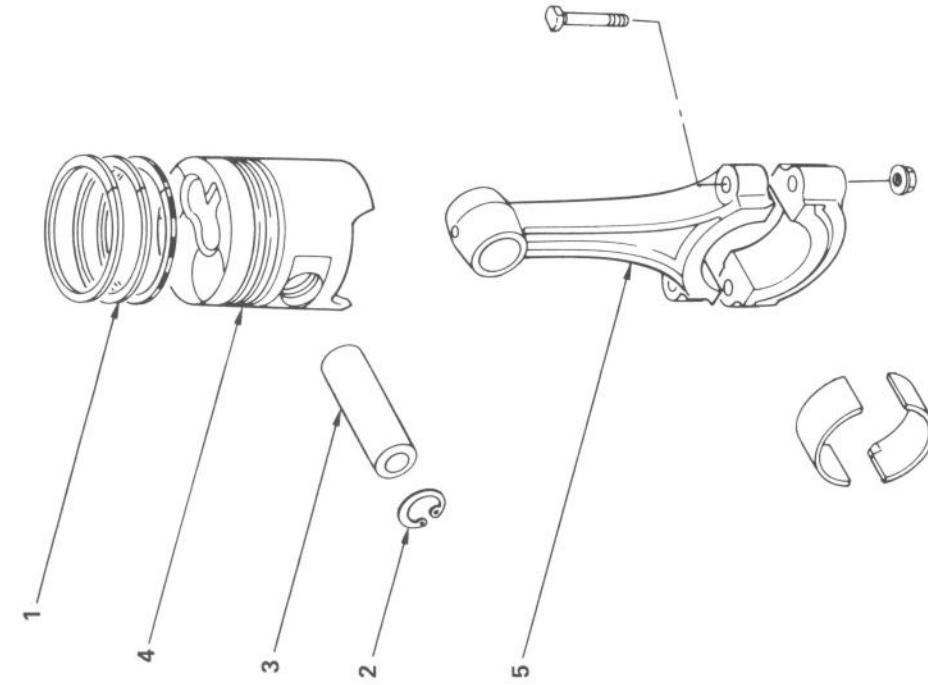
Important operation

- 1. Spring seat and split key
Compressor : 9-8523-1423-0



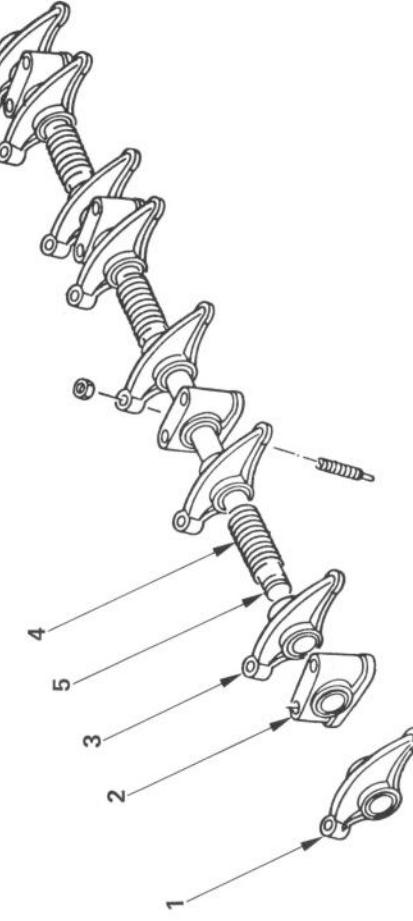
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PISTON AND CONNECTING-ROD ASSEMBLY

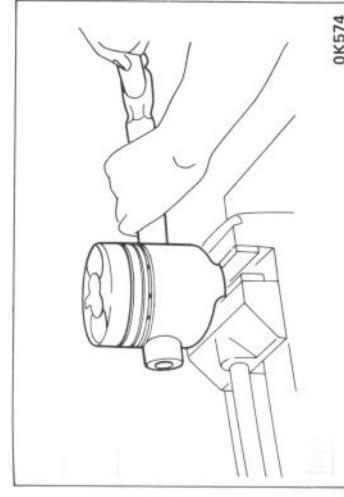
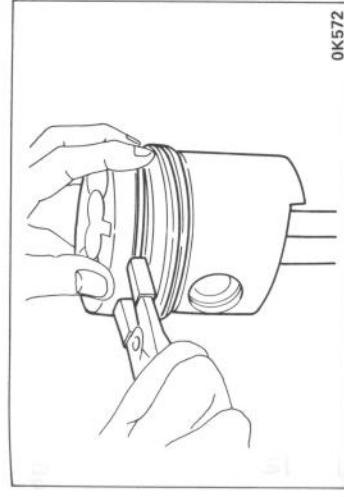


Disassembly steps

- ▲ 1. Piston ring
- ▲ 2. Snap ring
- ▲ 3. Piston pin
- 4. Piston
- 5. Connecting-rod

**Disassembly steps**

- 1. Rocker arm (A)
- 2. Rocker arm shaft bracket
- 3. Rocker arm (B)
- 4. Rocker arm shaft spring
- 5. Rocker arm shaft

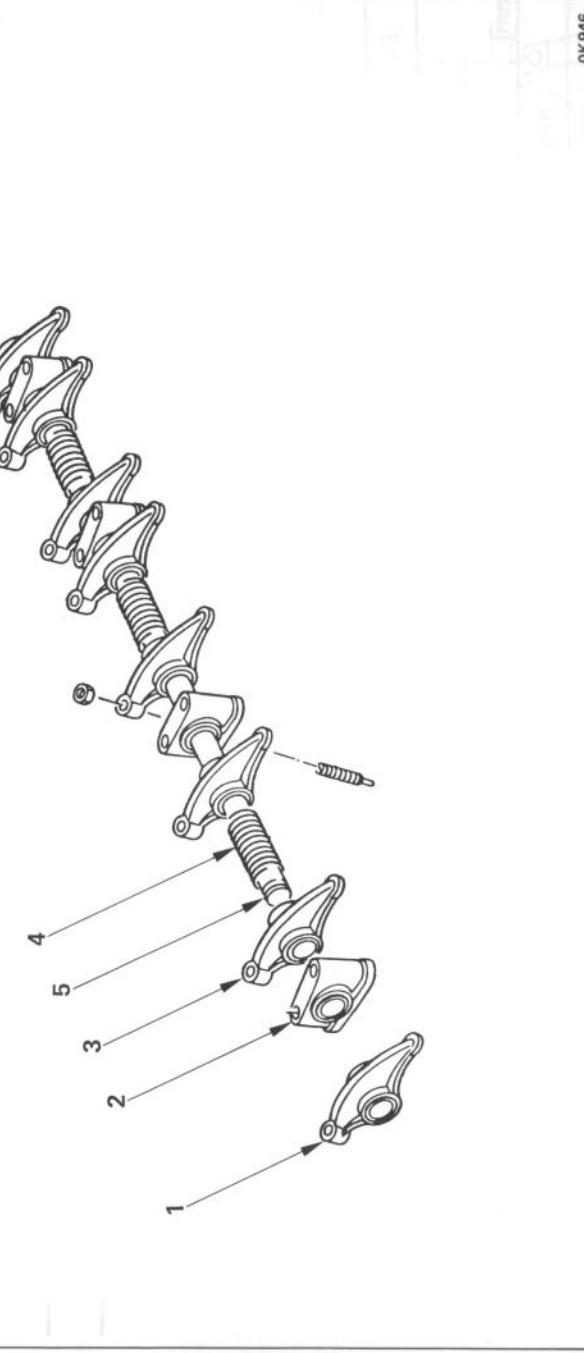
**! Important operations**

1. Piston ring Remover

3. Piston pin
Drive out the piston pin using a brass rod at normal temperature.

ROCKER ARM AND SHAFT ASSEMBLY

0K571



0K946

Disassembly steps

- 1. Rocker arm (A)
- 2. Rocker arm shaft bracket
- 3. Rocker arm (B)
- 4. Rocker arm shaft spring
- 5. Rocker arm shaft

5247-5248

5192 - 5193

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

CYLINDER BODY AND LINER



Cylinder body warpage

	Standard	Limit	(mm)
Overall length	0.05	0.2	
Thickness	C190 247.97 - 248.03 C240 247.97 - 248.03	247.72 247.77	
			(mm)



Cylinder liner bore diameter

	Standard	Limit	(mm)
Measuring point : Approx. 15 mm bellow upper face.			
	86.02 - 86.06	86.10	
			(mm)

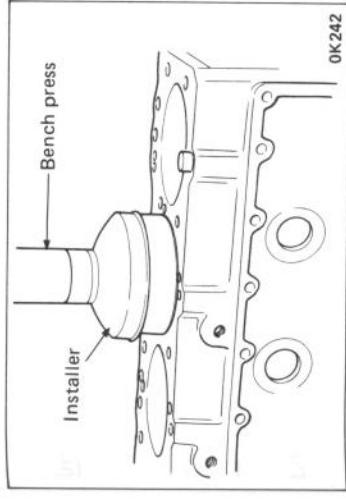
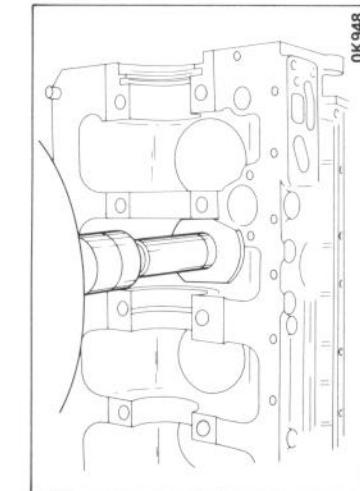


Amount of projection

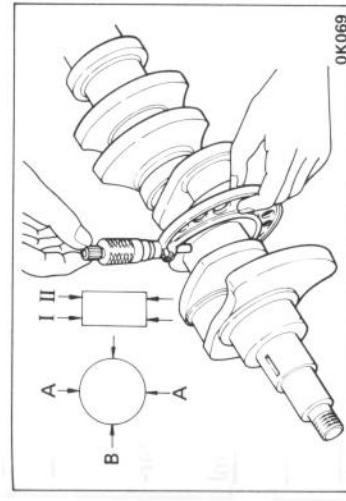
	Standard	(mm)	0 - 0.1	(mm)



Cylinder liner replacement
Remover : 9-8523-2552-0
Liner grip : 9-8522-1148-0



CRANKSHAFT AND BEARING



Crankshaft journal and pin diameter
C190GB, C190KE, C190
(mm)

	Journal	Pin	Standard
			59.92 - 59.93
			52.92 - 52.93

Undersize bearings are available in 4 different sizes which include 0.25, 0.5, 0.75 and 1.0 mm undersizes.

Crankshaft diameter when using undersize bearing
C190GB, C190KE, C190
(mm)

	Journal	Pin
U/S 0.25	59.67 - 59.68	52.67 - 52.68
U/S 0.50	59.42 - 59.43	52.42 - 52.43
U/S 0.75	59.17 - 59.18	52.17 - 52.18
U/S 1.00	58.92 - 58.93	51.92 - 51.93

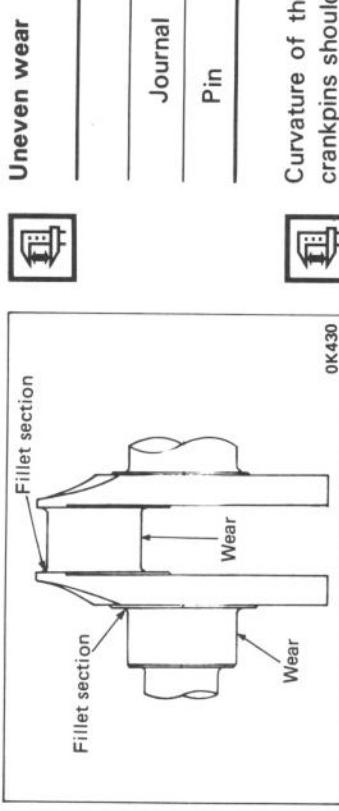
	Journal	Pin
U/S 0.25	69.67 - 69.68	52.67 - 52.68
U/S 0.50	69.42 - 69.43	52.42 - 52.43
U/S 0.75	69.17 - 69.18	52.17 - 52.18
U/S 1.00	68.92 - 68.93	51.92 - 51.93



Installer : 9-8523-2551-0

Wipe clean the cylinder liner and cylinder body to remove oil, then install the cylinder liner into cylinder bore using a bench press.

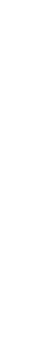
The use of dry ice to cool the cylinder liner will invite contraction, facilitating smooth installation of the cylinder liner.



	Uneven wear (mm)		
	Standard	Limit	
Journal	0.001	0.05	
Pin	0.001	0.05	

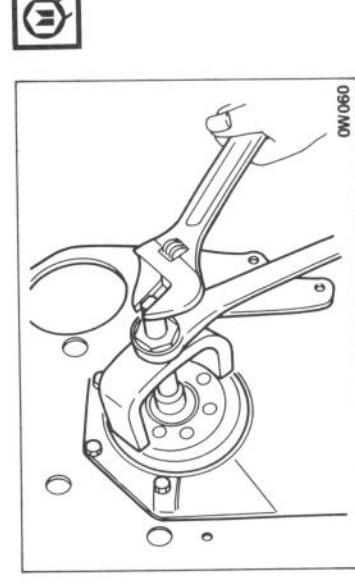
Curvature of the fillet section on the crankshaft journals and crankpins should be finished as shown below.

	Standard (mm)		
	Journal	3.3 – 3.7	
	Pin	3.3 – 3.7	



 **Pilot bearing replacement**
Remover : 9-8523-1812-0

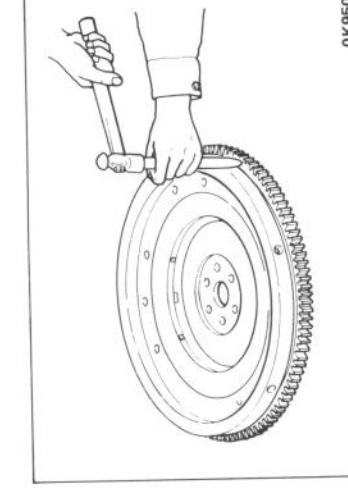
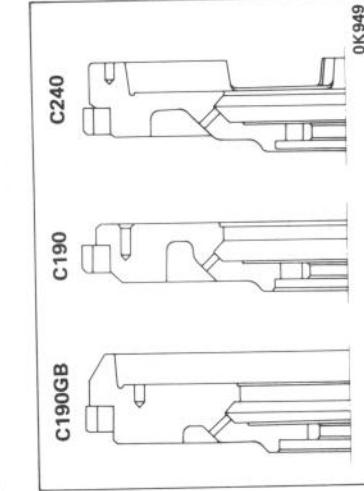
 Heat the ring gear evenly with a gas burner (Maximum temperature 200°C) to invite volumetric expansion. Install the ring gear on the flywheel when it is sufficiently heated.

**FLYWHEEL**

 Inspect the following parts for wear, damage or other abnormal conditions.

Fly wheel
Ring gear

Depth and thickness (mm)		
	Standard	Limit
C190GB, C190KE	17.9 – 18.1	19.0
C190	32.9 – 33.0	32.0
C240	17.9 – 18.1	19.0



 **Ring gear replacement**
Remove the ring gear from the flywheel by tapping around the side face of the gear with a brass bar.

PISTON**Piston clearance****Piston outside diameter**

Take measurement in direction at a right angle to the piston pin hole.

Grading position : 52 mm

The piston grade should be selected by referring to the following table, so that specified piston clearance can be obtained.

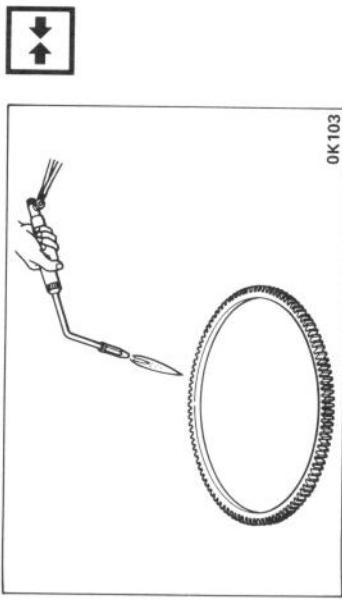
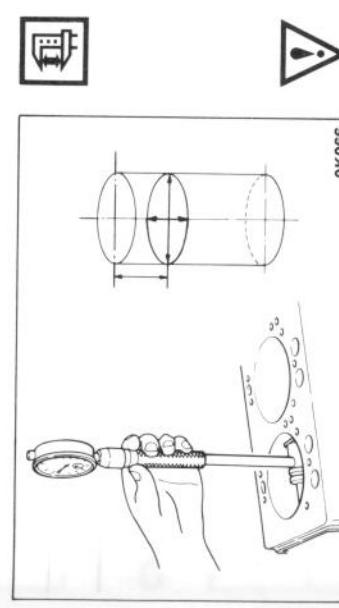
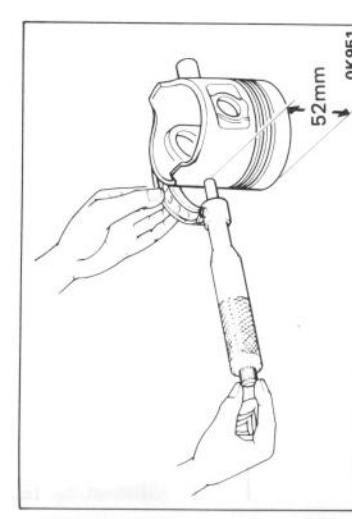
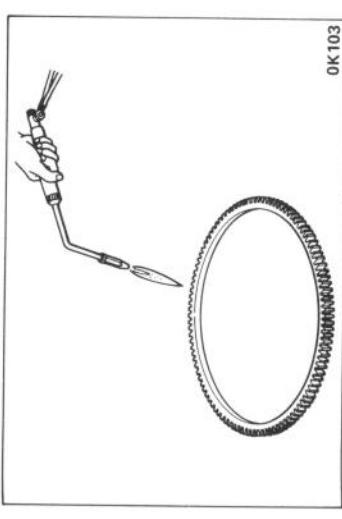
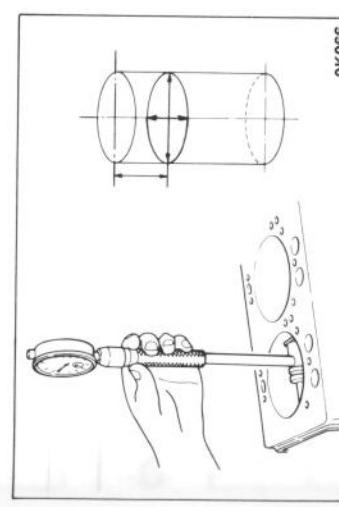
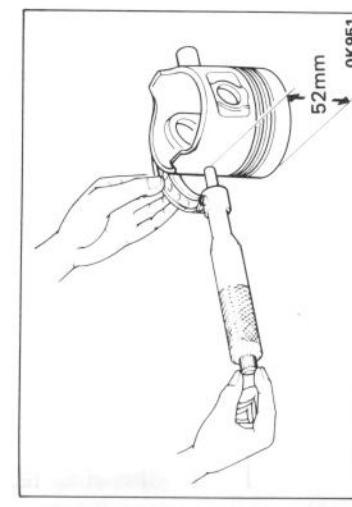
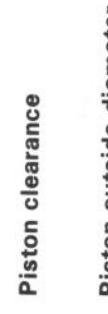
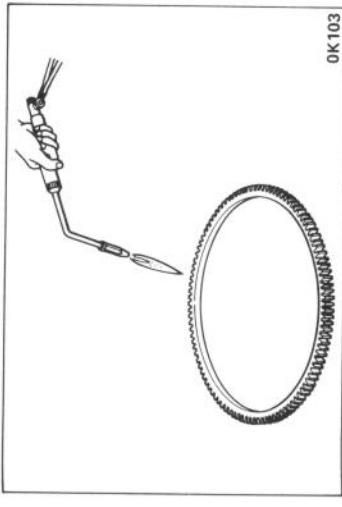
Piston outside diameter

Piston mark	Standard
A	85.888 – 85.907
C	85.908 – 85.927

Cylinder liner inside diameter

Cylinder liner inside diameter (mm)	Standard
Cylinder liner inside diameter	86.02 – 86.06
Piston clearance	0.123 – 0.143

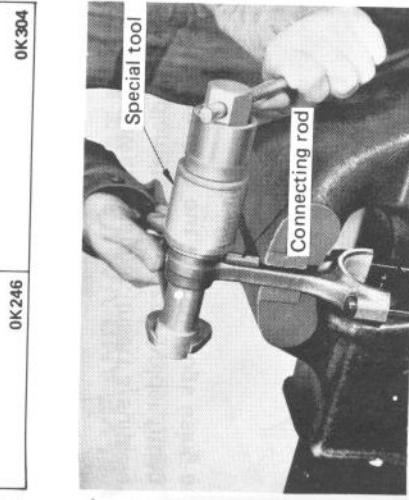
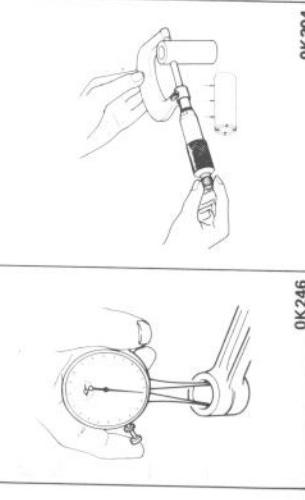
 C190KE model engine is not equipped with cylinder liner therefore, Oversize pistons and piston rings are prepared for repair.



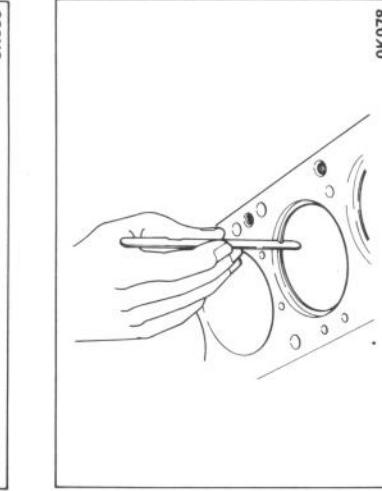
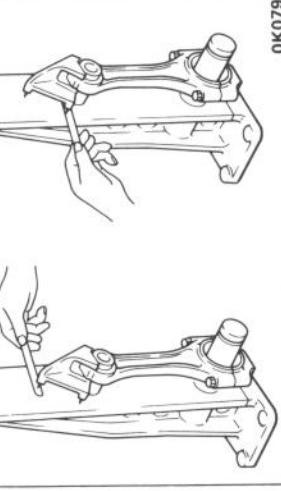
Piston pin outside diameter

	(mm)	
Standard	Limit	Limit
27.0 – 26.995	26.96	

Fitting interference between piston pin and piston.

Bushing**Piston ring gap**

	(mm)	
Standard	Limit	Limit
1st compression ring	0.09 – 0.11	0.3
2nd compression ring	0.03 – 0.06	0.3
Oil ring	0.02 – 0.05	0.15

**CONNECTING-ROD****Connecting-rod****CYLINDER HEAD****Bushing**

	Standard	Limit	Limit
Overall length	0.05	0.2	

**Cylinder head warpage**

	Standard	Limit	Limit
Thickness	91.95 – 92.05	91.75	



	Standard	Limit	Limit
Overall length	0.05	0.2	

	Standard	Limit	Limit
Thickness	91.95 – 92.05	91.75	

	Standard	Limit	Limit
Overall length	0.05	0.2	

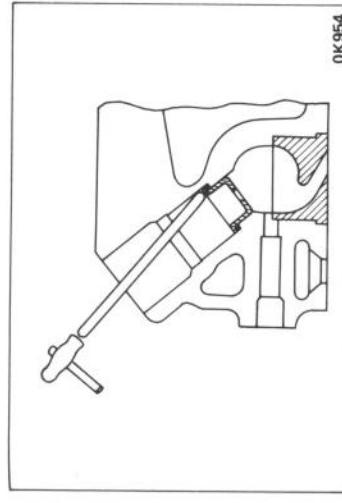
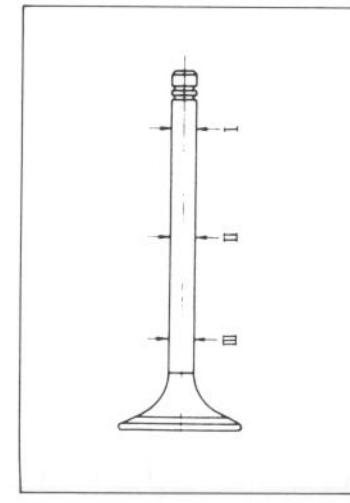
Depression of hot plugs

Check the amount of depression of hot plugs on No. 1 through No. 4 cylinders using a feeler gauge, with a straight edge held against the hot plug face.

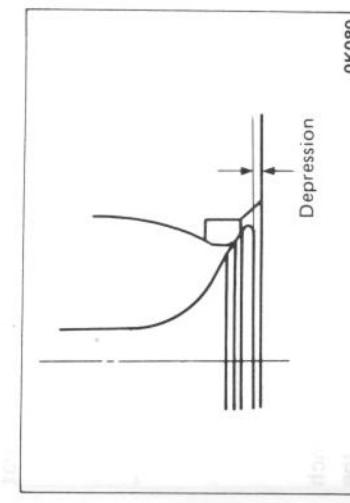
Limit (mm)	0.02
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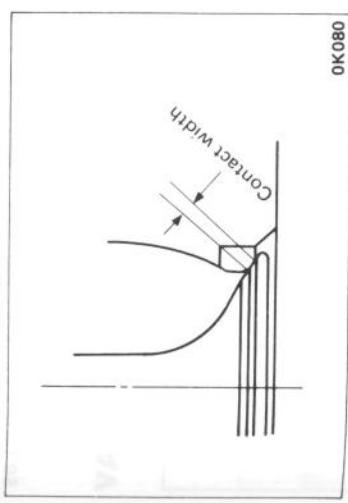
Installation of new heat shield
Install the heat shield with the flanged side up on the cylinder head by tapping on the flange lightly with a brass bar.

**VALVE AND VALVE SEAT INSERT**

Valve stem diameter (mm)	
Intake valves	7.949 – 7.961
Exhaust valve	7.921 – 7.936

Depression

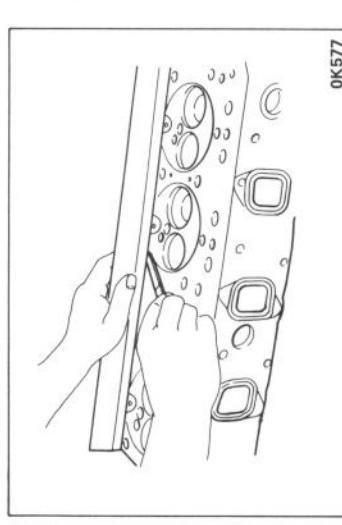
Depression (mm)	
Intake valves	0.7
Exhaust valves	0.7

Contact width

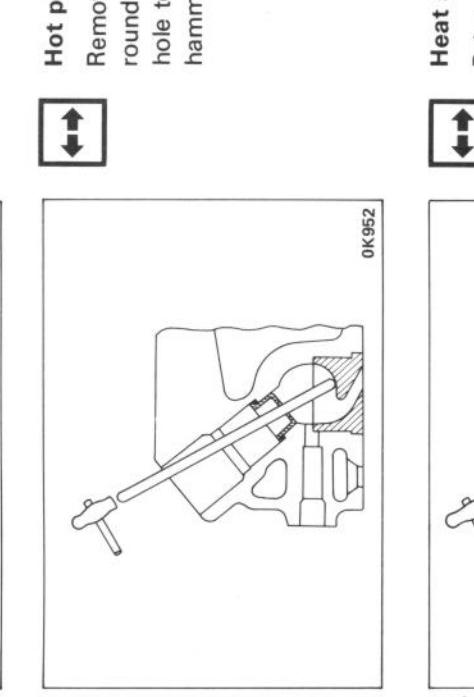
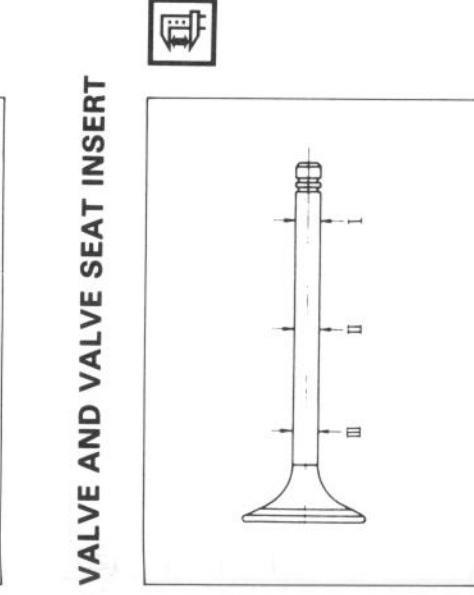
0K080

Standard	Limit
1.2 – 1.5	3.6

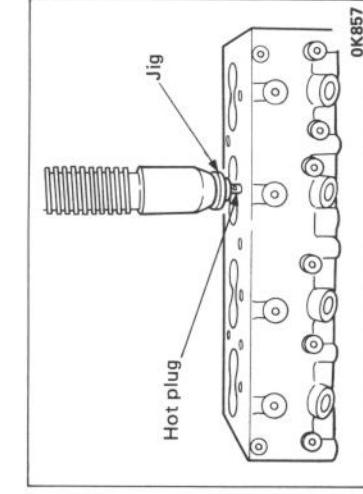
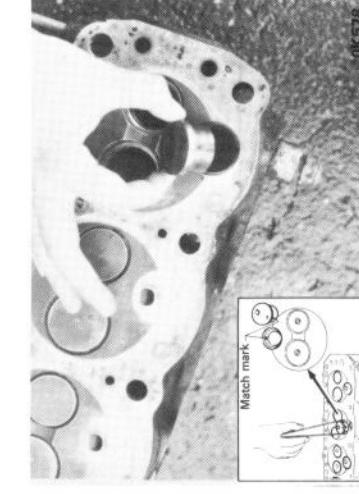
Hot plug replacement
Remove the hot plug in the following manner: Insert a suitable round bar sizing 3 to 5 mm in diameter into nozzle holder fitting hole to touch the hot plug, then drive out the hot plug using a hammer.

**Heat shield replacement**

Drive out the heat shield using a brass bar and hammer.

**Installation of new hot plug**

Install lock ball into groove in hot plug. Drive the hot plug into cylinder head by aligning lock ball in hot plug with groove in cylinder head.



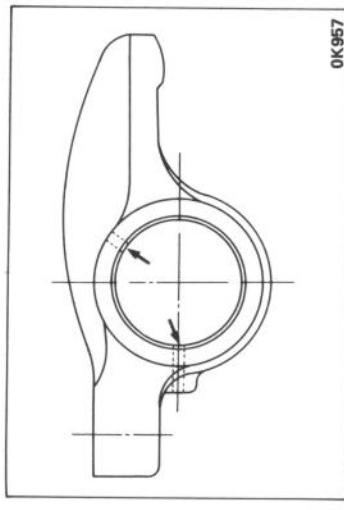
0K080

Standard	Limit
1.2 – 1.5	3.6

After installation
Press the hot plug into position by applying 4500 to 5000kg pressure using a bench press with a piece of metal fitted against the hot plug face for protection.

After installation, grind the face of hot plug flush with the face of the cylinder head.

It is necessary to drill an oil port in the new rocker arm bushing as it is not provided with oil port.



0K957

ROCKER ARM SHAFT AND ROCKER ARM ASSEMBLY

Spring tension

	Set length	Standard	Limit
Inner	37.0 mm	5.55 – 6.25	5.02
Outer	39.0 mm	19.65 – 22.15	18.1

Run-out

	Limit (mm)	0.6
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Rocker arm shaft diameter

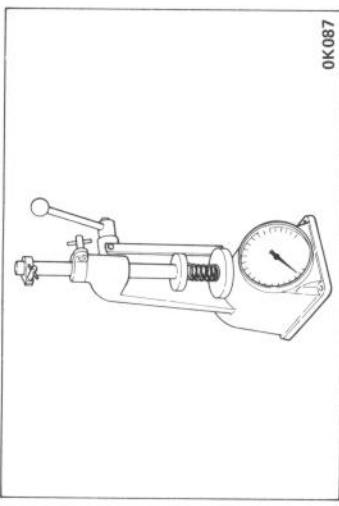
	Standard	Limit
18.98 – 19.00	18.85	

Camshaft diameter and height of cam lobe

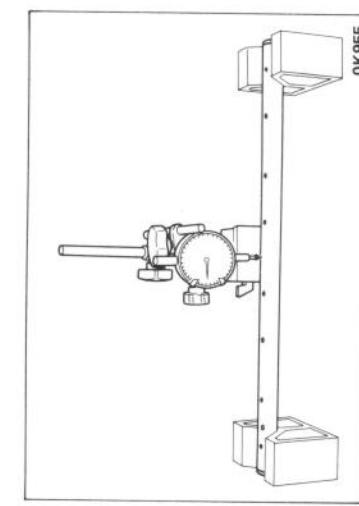
	Standard	Limit
Journal diameter	47.94 – 47.97	47.6
Height of cam lobe	40.57	40.2

Clearance between camshaft and bearing

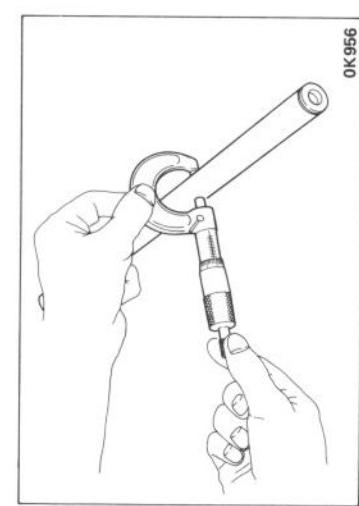
	Standard	Limit
0.05	0.12	0.12



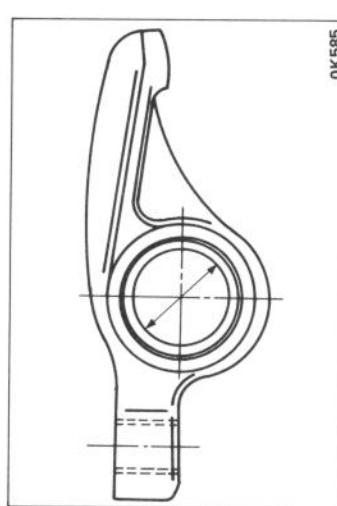
0K087



0K955



0K956

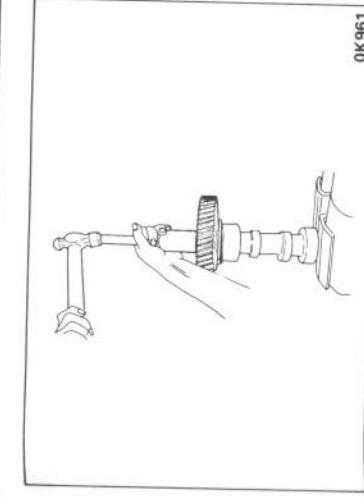


0K244

If the amount of wear is beyond the limit, replace either the shaft or rocker arms depending on the condition of wear.

Cam bearing replacement

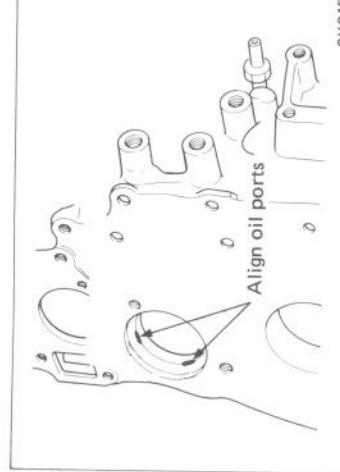
- Removal
 Remover and installer : 9-8523-1737-0 or
9-8523-1360-0



0K959

Installation

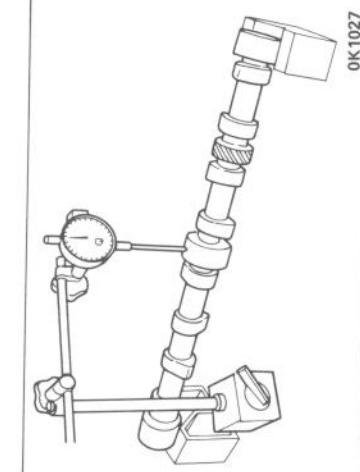
- The oil port in the cylinder body must be aligned with that in the camshaft bearing.
 Remover and installer : 9-8523-1737-0 or
9-8523-1360-0



0K245

Run out

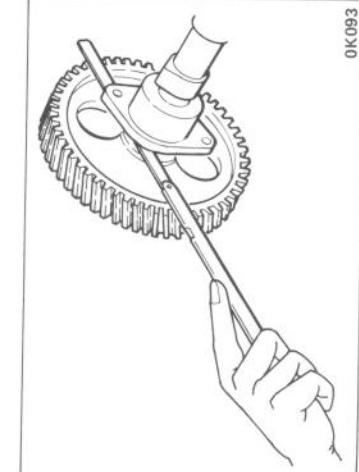
Standard	Limit	(mm)
0.05	0.1	



0K1027

End play (C190, C240 only)

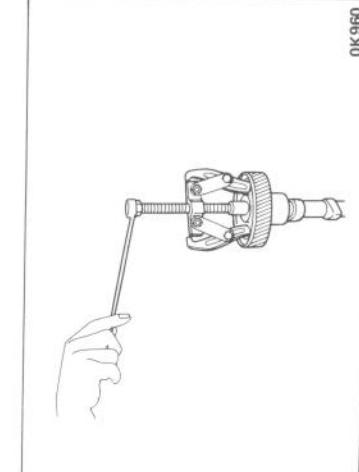
Standard	Limit	(mm)
0.05 — 0.11	0.2	



0K093

Camshaft gear replacement (C190, C240 only)

- Removal
 Remover : 5-85210-002-0

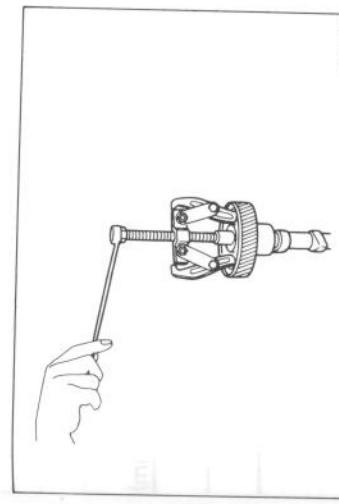


0K960

- Installation**
Drive the gear to the shaft aligning the key groove on the gear with the key on the shaft.

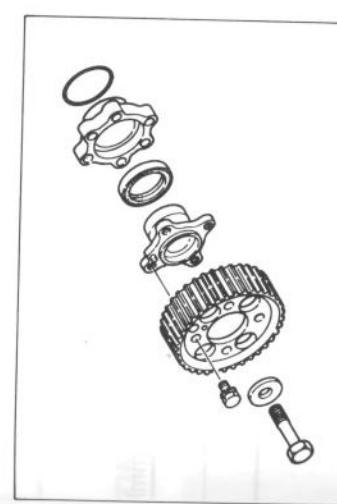
C190GB only

- Removal
Remover : 5-85210-002-0



0K960

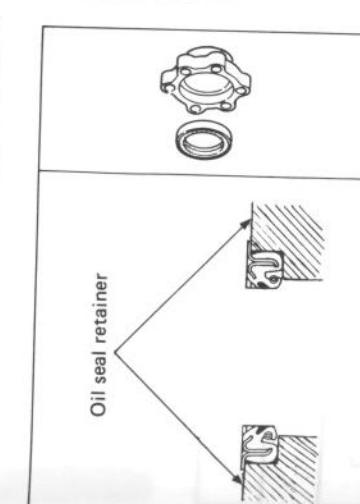
- Inspect the following parts for wear, damage or other abnormal conditions



0K962

Oil seal replacement

- Removal
Drive out the oil seal using a brass bar against the side with boss.
 Installation
Install the oil seal flush with the retainer face.

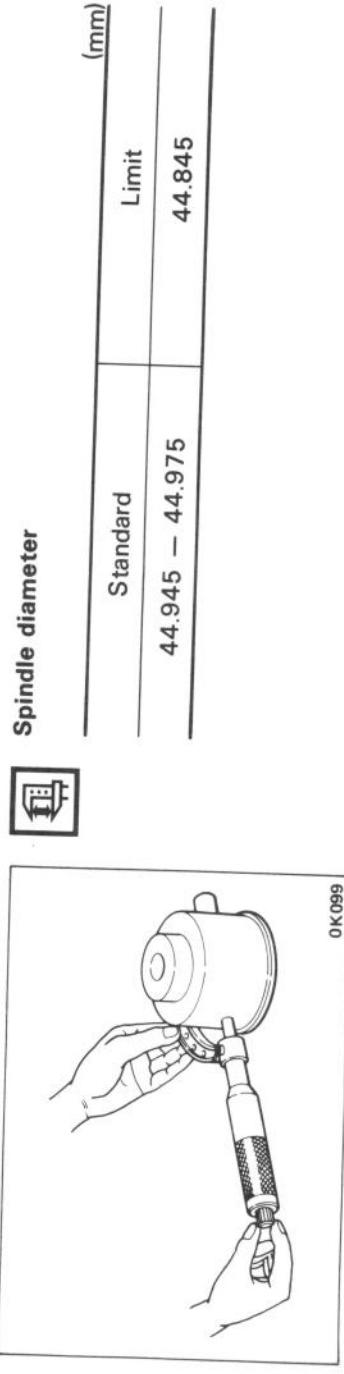


0K962

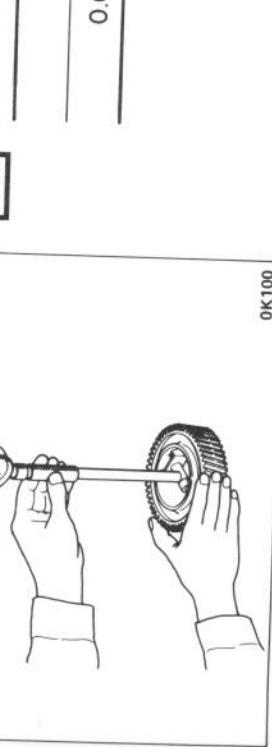
TAPPET



IDLER GEAR AND SPINDLE (C190, C240 only)



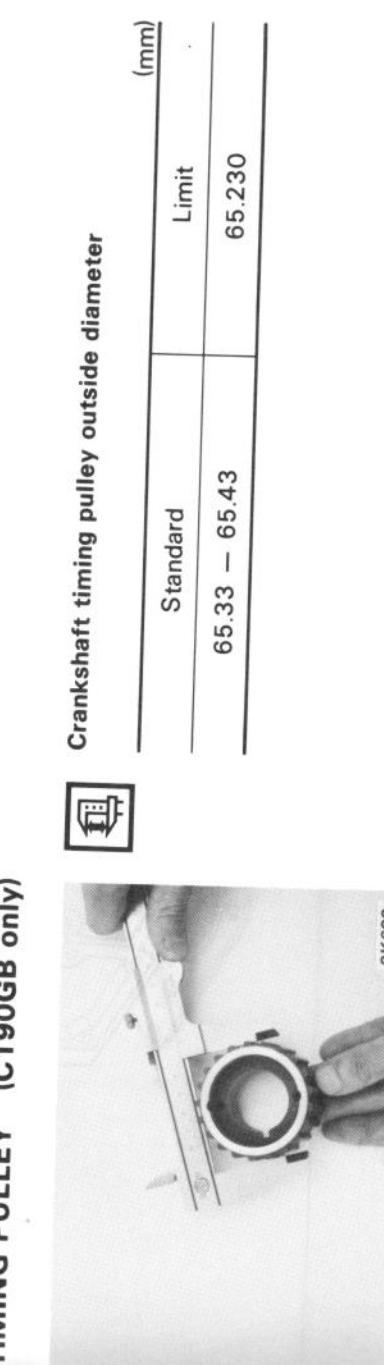
	Standard	Limit	(mm)
	44.945 – 44.975	44.845	



Clearance between spindle and idler gear

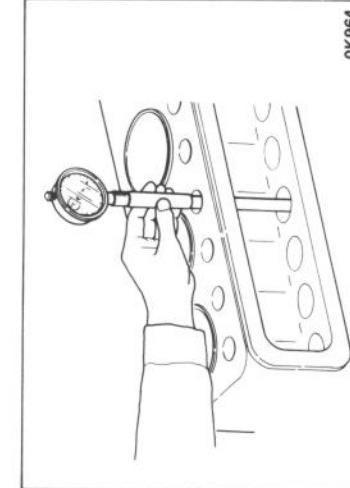
	Standard	Limit	(mm)
	0.025 – 0.085	0.2	

TIMING PULLEY (C190GB only)

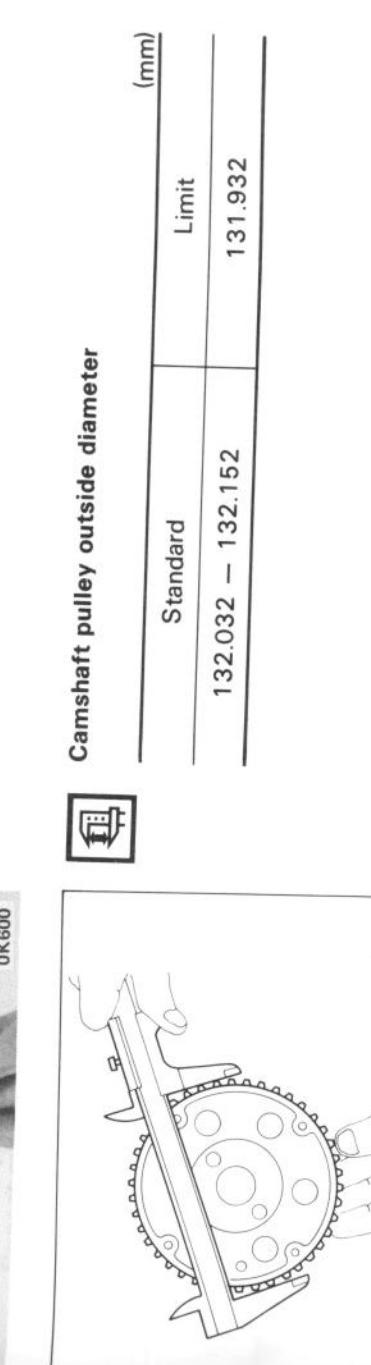


Clearance between tappet and cylinder body

	Standard	Limit	(mm)
	0.03	0.1	

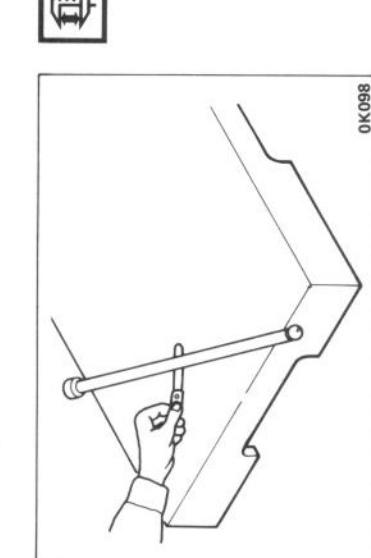


PUSH-ROD



Camshaft pulley outside diameter

	Standard	Limit	(mm)
	132.032 – 132.152	131.932	

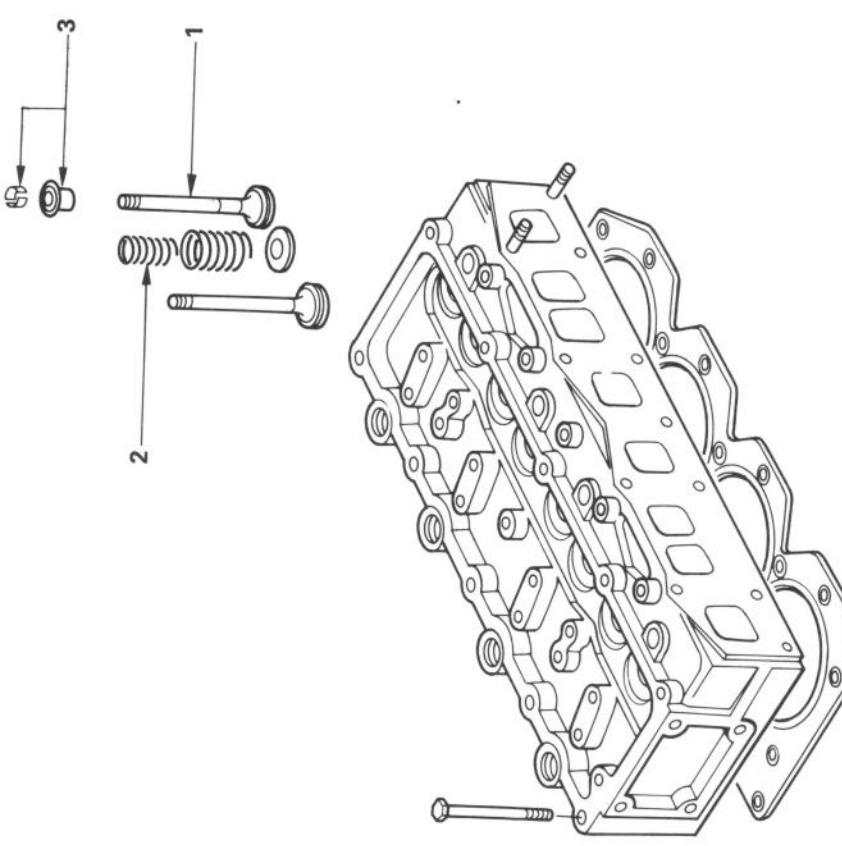


Run-out

	Limit	(mm)	0.3


Injection pump pulley outside diameter

	Standard	Limit	(mm)
	132.032 – 132.152		131.932


REASSEMBLY
MINOR COMPONENTS
CYLINDER HEAD


0K945

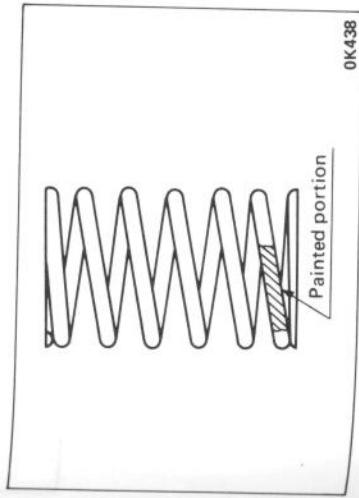
Reassembly steps

- 1. Valve
- ▲ 2. Valve spring

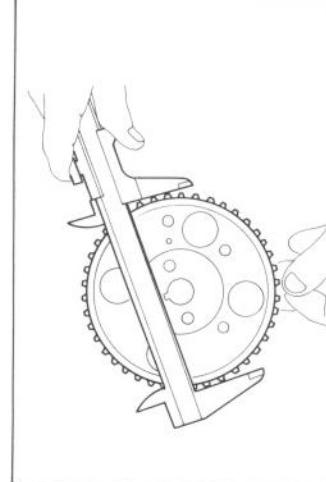
- ▲ Removal
 - Installation
- Installer : 5-852220-013-0


Important operations

- ▲ 3. Spring seat and split key
- 2. Valve spring
Install the valve springs with the painted end down.



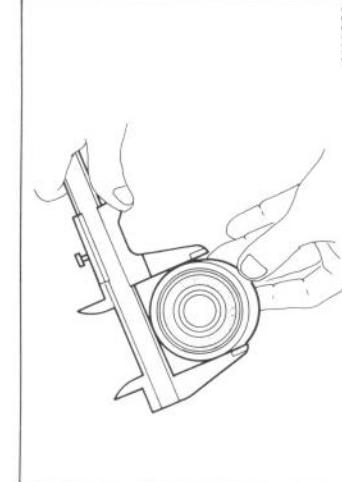
0K438


Timing gear case cover oil seal replacement
(C190, C240)


0K1029

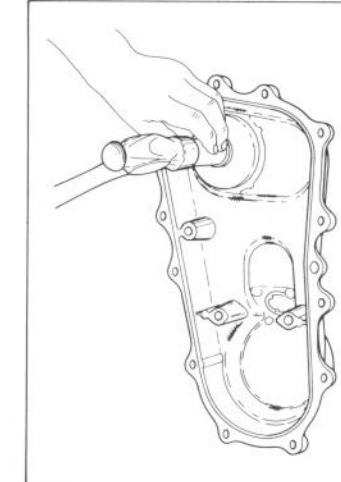
Tension bearing outside diameter

	Standard	Limit	(mm)
	61.8 – 62.0		61.6

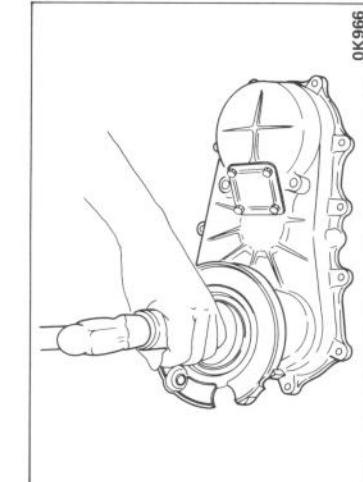


0K1030

Timing gear case cover oil seal replacement
(C190, C240)

Removal


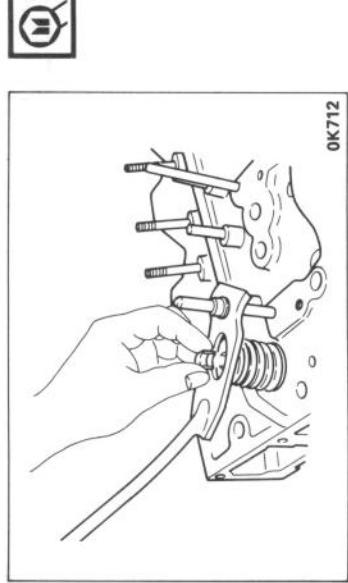
0K965


Installation


0K966



3. Spring seat and split key
Compressor : 9-8523-1423-0



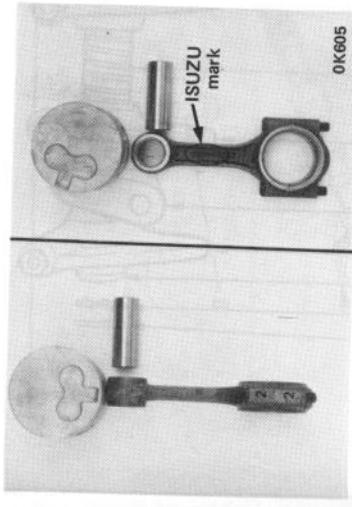
PISTON AND CONNECTING-ROD ASSEMBLY



Important operations

1. Piston and connecting-rod

Install the piston on the connecting-rod, so that combustion chamber on piston head is on the same side with the cylinder number mark side (side with bearing stopper) of the connecting-rod big-end.
Isuzu mark on the connecting-rod should be on the same side of the front mark on the piston head.

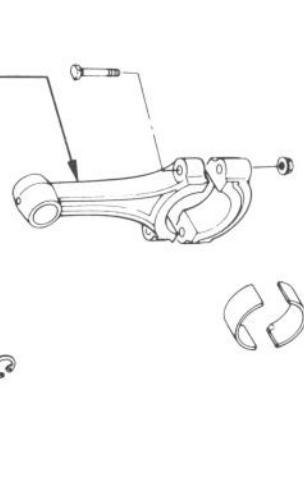
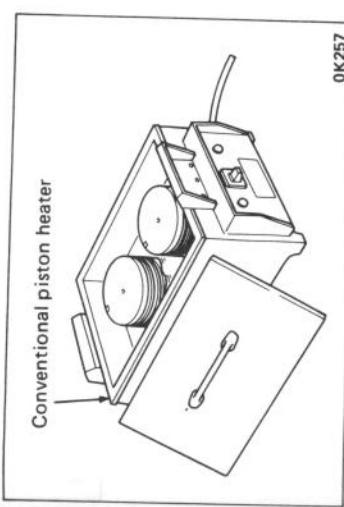


PISTON AND CONNECTING-ROD ASSEMBLY



2. Piston pin

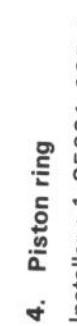
Install the piston pin after heating the piston to about 100°C.



Reassembly steps

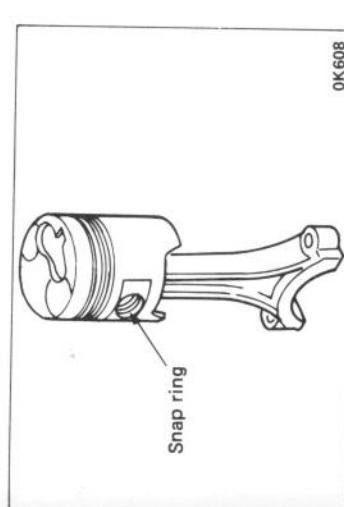
- ▲ 1. Piston and connecting-rod
- ▲ 2. Piston pin
- ▲ 3. Snap ring
- ▲ 4. Piston ring

Piston ring gaps should be positioned as shown in the figure.



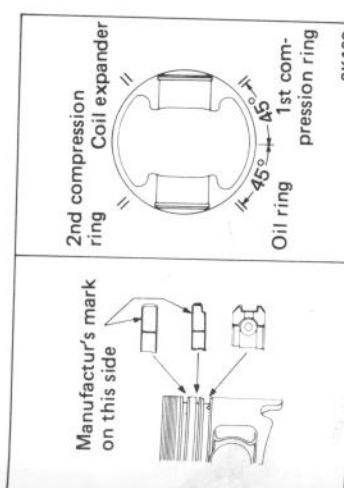
3. Snap ring

Install the snap ring into the piston using snap ring pliers, then check to make certain the snap ring is fitted properly into the groove.

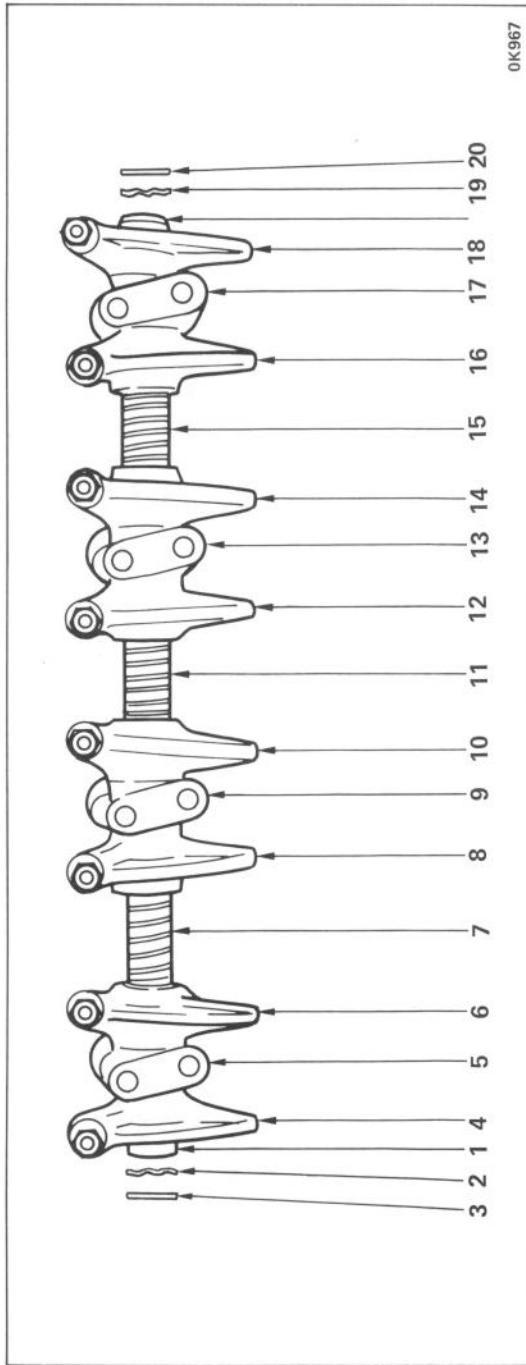


4. Piston ring

Installer : 1-85221-025-0
Install the 1st and 2nd compression rings with manufacturer's mark turned up. Oil ring can be installed on the piston with either side up.
Piston ring gaps should be positioned as shown in the figure.



ROCKER ARM AND SHAFT ASSEMBLY



Reassembly steps

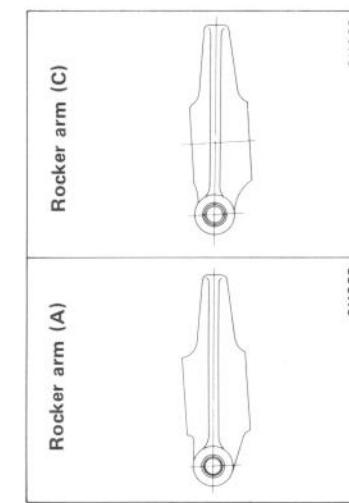
1. Rocker arm shaft
2. Waving washer
3. Snap ring
- ▲ 4. Rocker arm (A)
5. Rocker arm shaft bracket
- ▲ 6. Rocker arm (D)
7. Spring
- ▲ 8. Rocker arm (C)
9. Rocker arm shaft bracket
- ▲ 10. Rocker arm (D)
11. Spring
- ▲ 12. Rocker arm (C)
13. Rocker arm shaft bracket
- ▲ 14. Rocker arm (D)
15. Spring
- ▲ 16. Rocker arm (C)
17. Rocker arm shaft bracket
- ▲ 18. Rocker arm (B)
19. Waving washer
20. Snap ring



Important operations

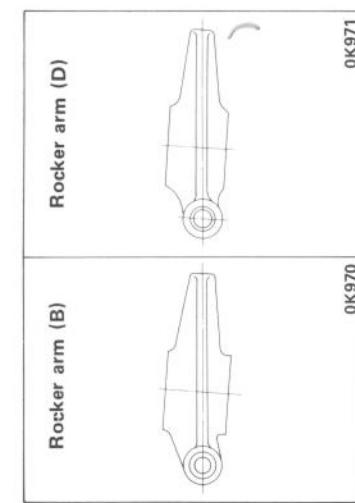
4. Rocker arm (A)
8. 12. 16. Rocker arm (C)

Difference between rocker arm A and C.



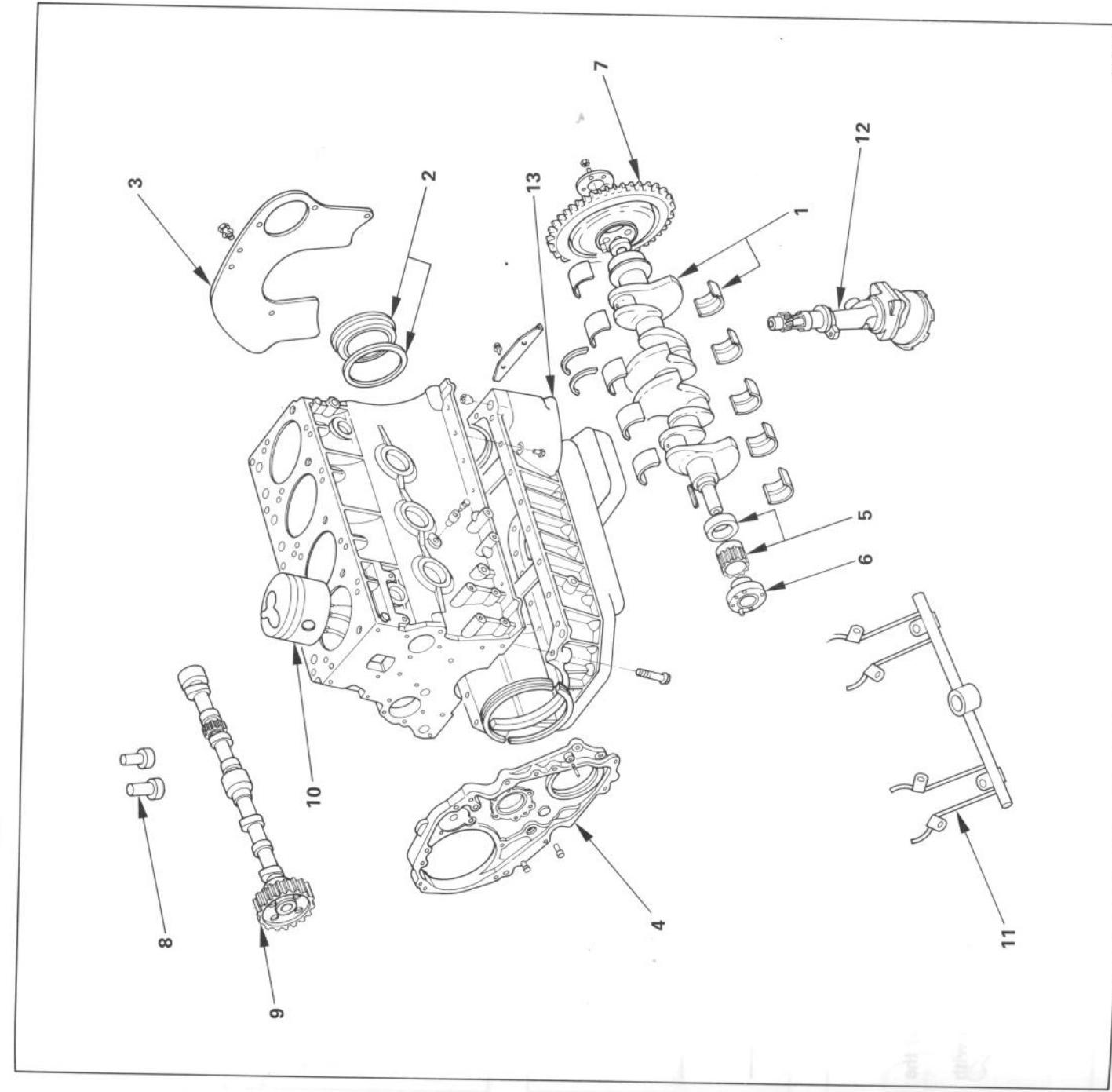
18. Rocker arm (B)
6. 10. 14. Rocker arm (D)

Difference between rocker arm B and D.



INTERNAL PARTS I

MAJOR COMPONENT



Reassembly steps

- ▲ 1. Crankshaft and bearing
- ▲ 2. Rear oil seal
- 3. Rear plate
- 4. Timing pulley housing
- ▲ 5. Crankshaft timing pulley
- ▲ 6. Crankshaft pulley center (C190GB only)
- ▲ 7. Flywheel
- 8. Tappet
- 9. Camshaft assembly
- ▲ 10. Piston and connecting-rod
- ▲ 11. Oiling jet
- ▲ 12. Oil pump
- ▲ 13. Crankcase and oil pan

! Important operation

1. Crankshaft and bearing

The following points should be noted to avoid interchanging the crankshaft for C190 model engine with that from C240 model.

	C190 model (mm)	C240 model (mm)
Journal diameter	60	70

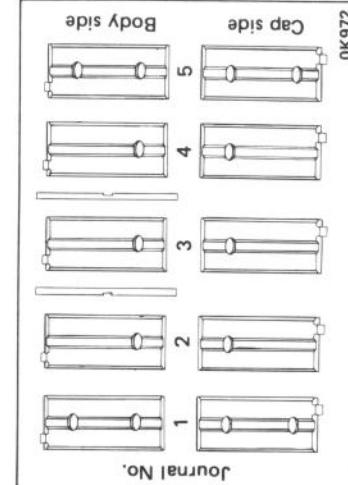
Install the crankshaft after applying engine oil to the face of the bearing in contact with the crankshaft.

The bearings should be installed correctly in their respective position. Install the thrust bearing with the oil grooved side turned outward.

With oil hole and groove

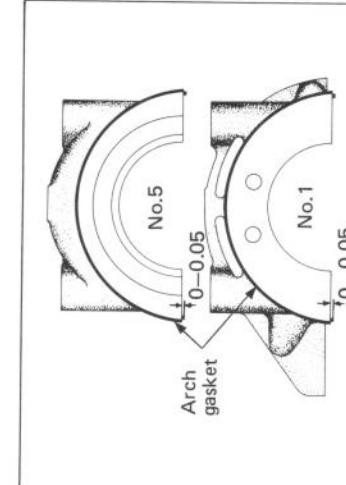
Fit correctly

0K265

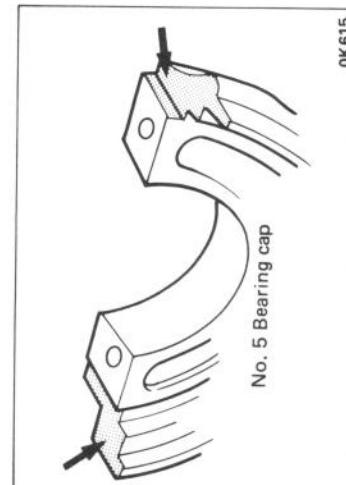


Installation of bearing cap arch gaskets
Install the arch gasket on the No. 1 and No. 5 bearing caps.

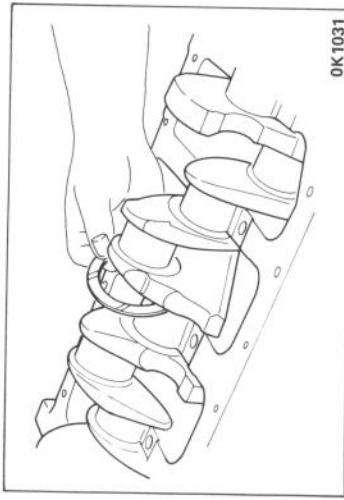
Amount of projection of gasket (mm)	0 – 0.05
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Apply a coat of silicone gasket evenly to the joining faces of the No. 5 bearing cap and cylinder body.
The No. 1 and No. 5 bearing caps should be installed flush with the face of the cylinder body.



Install front and rear side thrust bearings with the oil groove turned to the timing gear and flywheel, respectively.



Tighten crankshaft bearing cap bolts in numerical order.

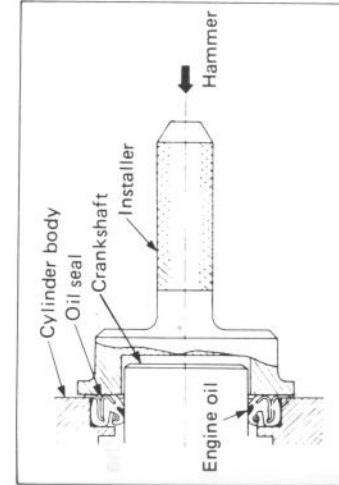
Bolt length (mm)	Torque (kg-m)	16 – 18
C190GB, C190	89	
C240	97	

2. Rear oil seal

Apply engine oil to the lipped portion of the rear oil seal, then install it in position using installer.

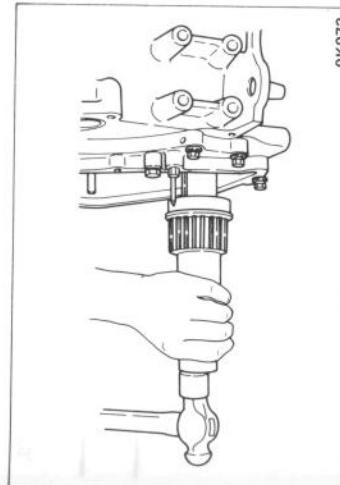


Installer : 9-8522-1279-0



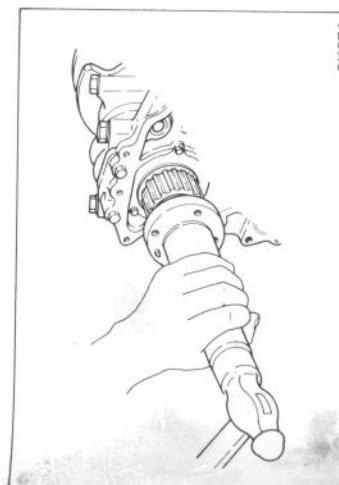
5. Crankshaft timing pulley (C190GB only)

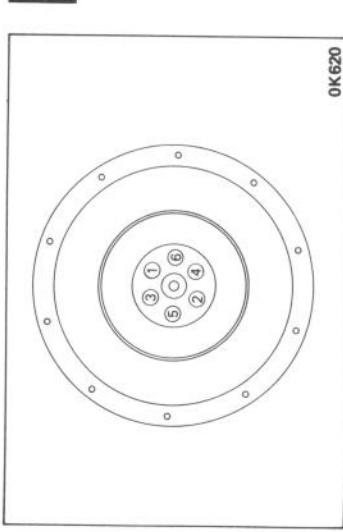
Installer : 9-8522-0021-0



6. Crankshaft pulley center (C190GB only)

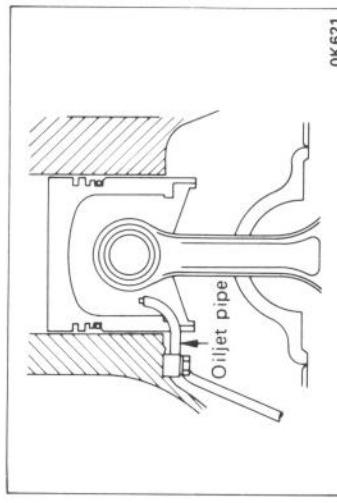
Installer : 9-8522-0021-0



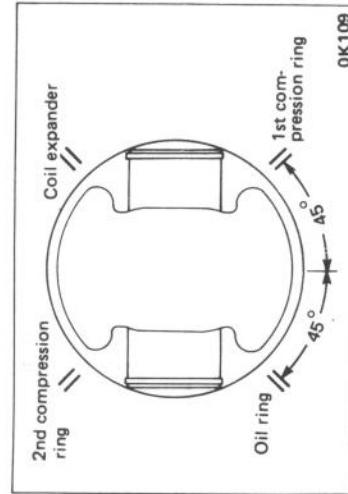


7. Flywheel
Tighten the bolts in the numerical order as the illustration.

Torque	(kg-m)	120
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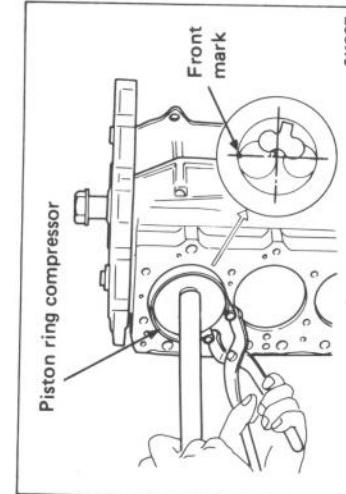


Turn the crankshaft and check to make certain oil jet pipe is apart from the piston.



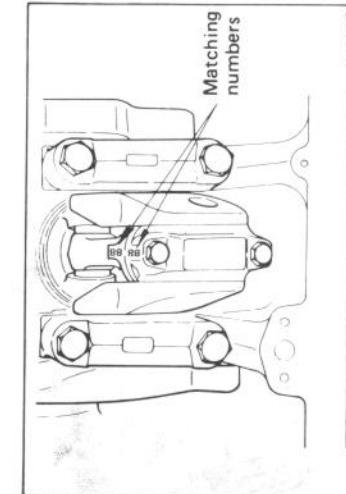
10. Piston and connecting-rod

Lightly oil the piston rings fitted to the piston, then position piston ring gaps as illustrated in the drawing.



Piston ring compressor : 9-8522-1255-0

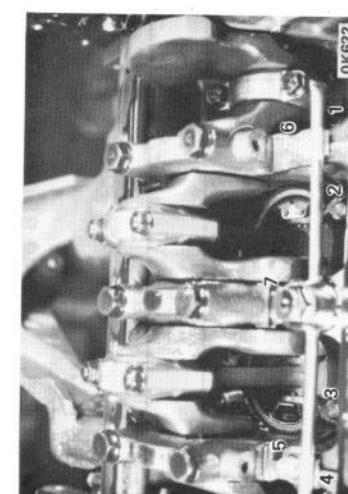
Install the piston and connecting-rod with mark turned to the front of engine.



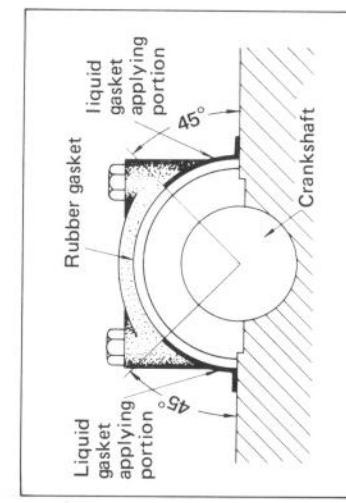
Install the connecting-rod bearing caps by matching numbers.



Torque	(kg-m)	8.0 — 9.0
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11. Oiling jet
Tighten oiling jet pipe fixing bolts in numerical sequence.



Turn the crankshaft and check to make certain oil jet pipe is apart from the piston.

13. Crankcase

Apply liquid gasket to the arch gasket fitting face of the No. 1 and No. 5 bearing caps.

0K621

0K621

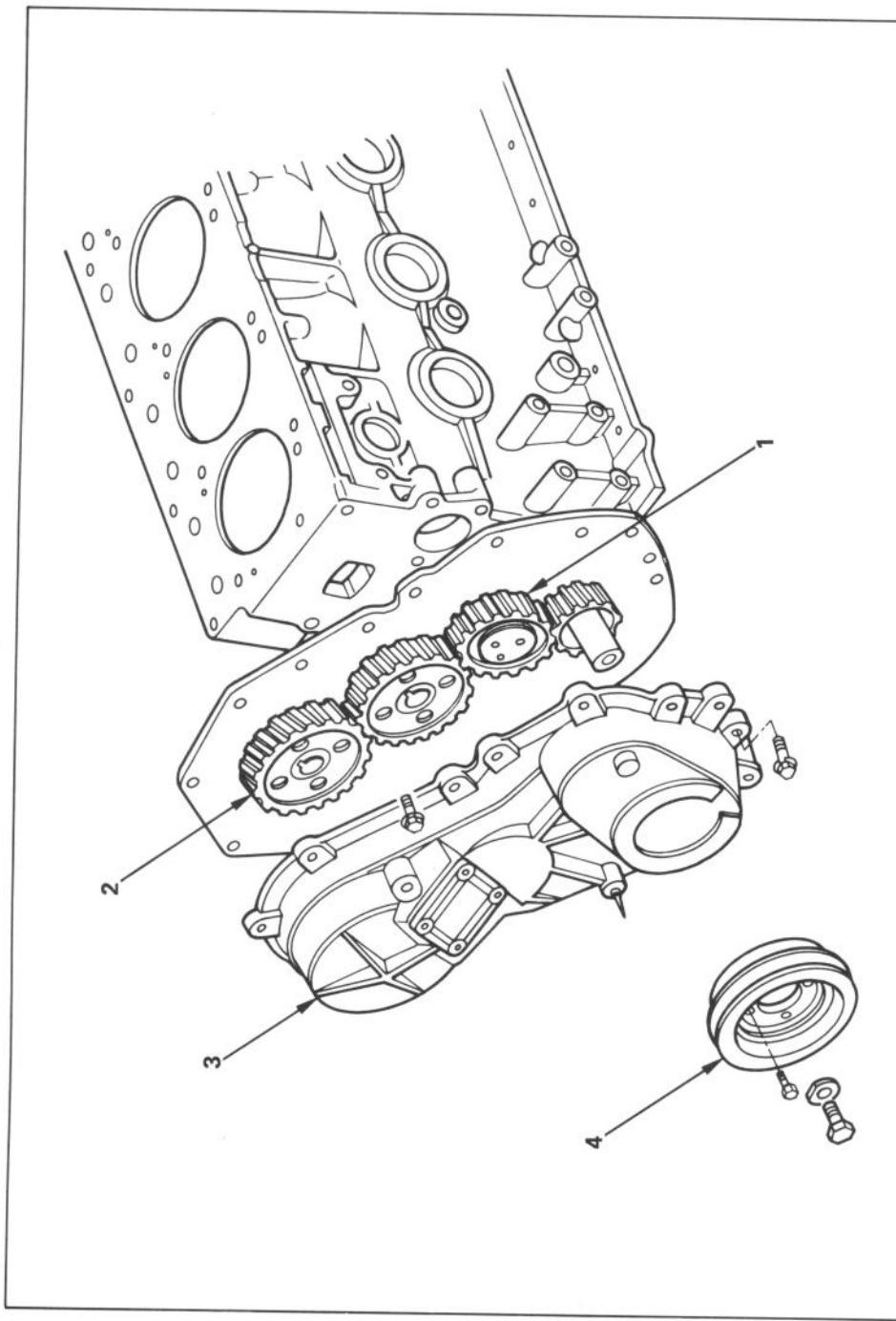
0K621

0K621

INTERNAL PARTS (Timing gear train)

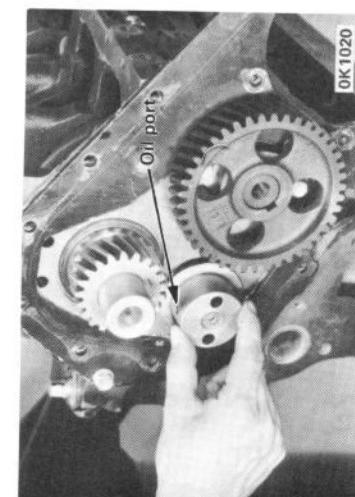
MAJOR COMPONENTS

Gear drive type



Reassembly steps

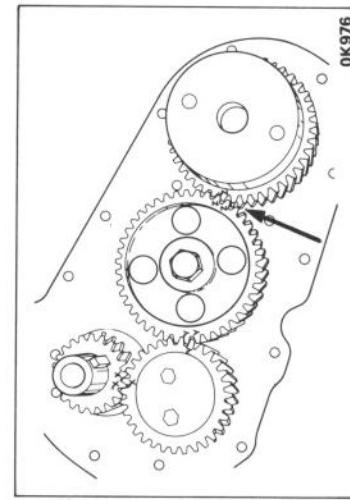
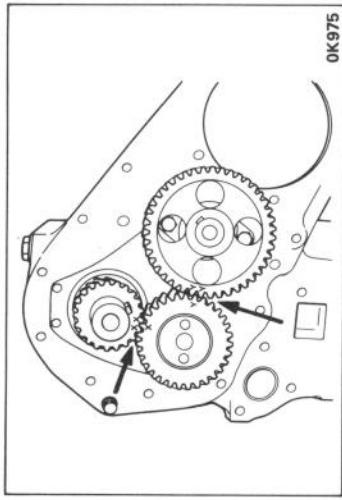
- ▲ 1. Idler gear assembly
- ▲ 2. Injection pump gear
- ▲ 3. Timing case cover
- ▲ 4. Damper pulley



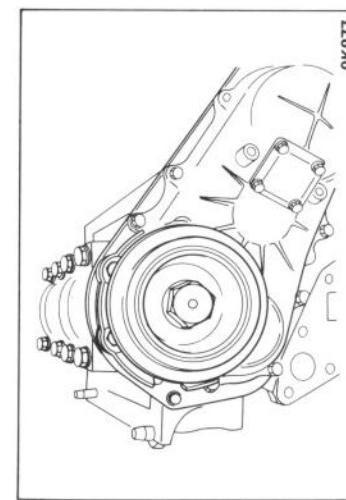
1. **Idler gear**
Install the idler gear, so that the oil port in the idler gear shaft is turned to the crankshaft gear side and bolt holes are aligned.

Align the marks on the camshaft gear, idler gear and crankshaft gear.

2. **Injection pump gear**
Install the injection pump gear together with injection pump by aligning the mark with that on the camshaft.

3. **Timing case cover**

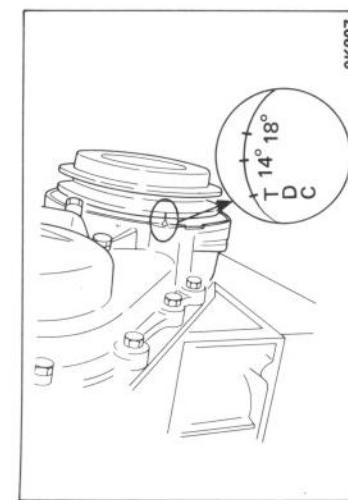
Check to make certain the O-ring is fitted properly into ring groove in the timing gear case cover.

4. **Pulley**

Torque (kg-m)	19.0

Injection timing adjustment

Bring the piston in No. 1 cylinder to the injection timing before T.D.C. on compression stroke, so that TDC line on the pulley is aligned with the pointer.

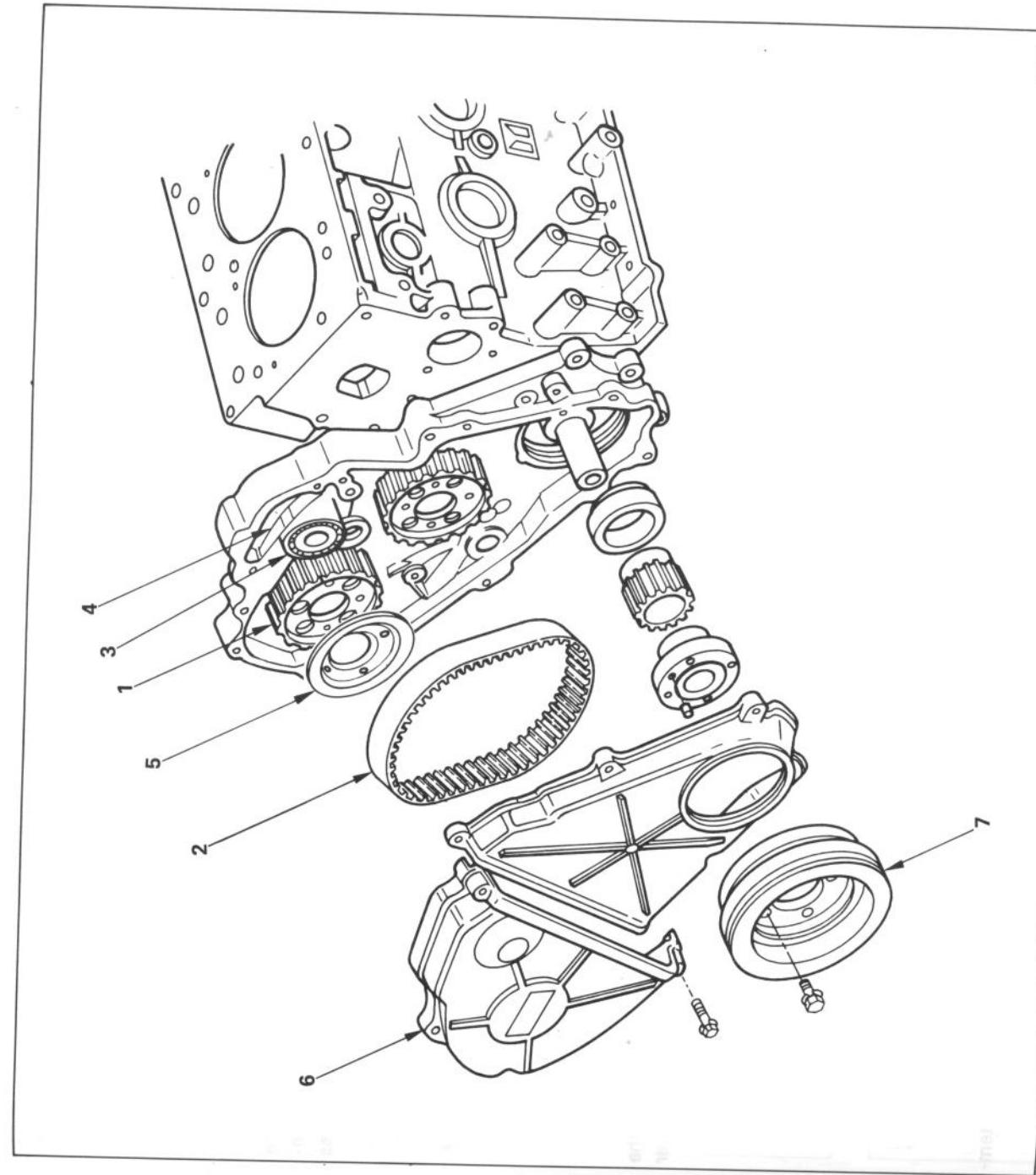


 Bring the mark on the injection pump housing with the mark on the injection pump bracket.

INTERNAL PARTS (Timing gear train)

MAJOR COMPONENTS

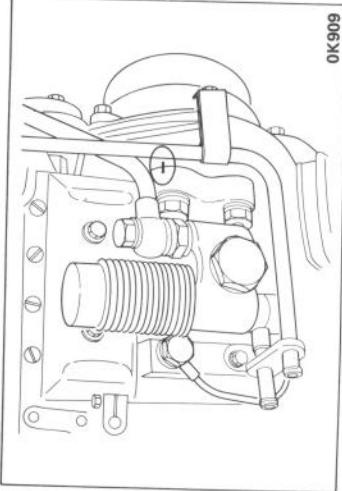
Belt drive type



Reassembly steps

- 1. Injection pump gear
- ▲ 2. Timing belt
- ▲ 3. Tension bearing and center
- ▲ 4. Tension spring
- ▲ 5. Frange
- 6. Pulley housing cover
- 7. Pulley

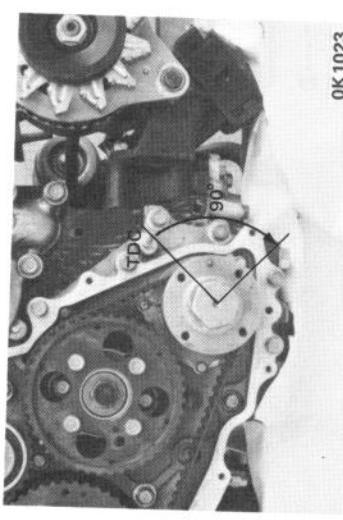
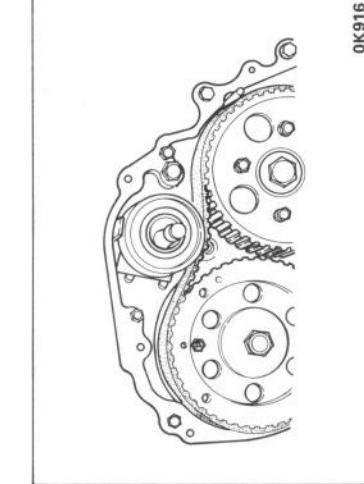
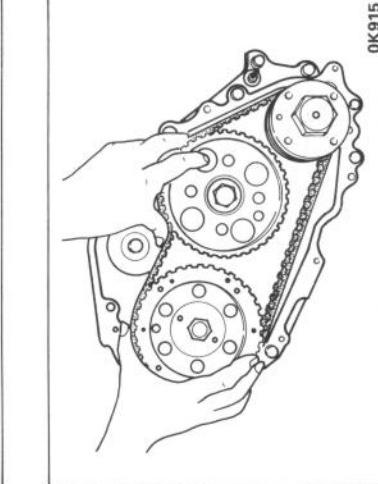
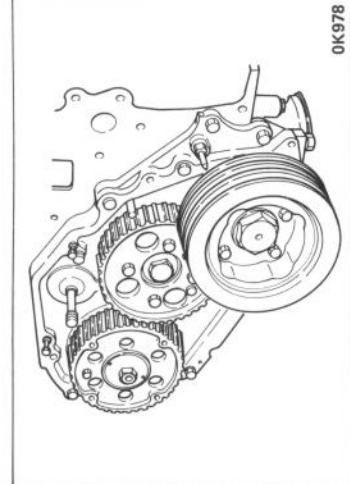
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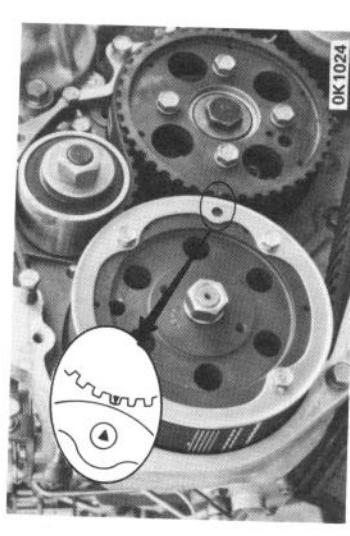
! **Important operations**

2. Timing belt

Install the damper pulley and align the TDC mark on the pulley with the pointer and mark "▲" on the injection pump pulley with the mark "▲" on the camshaft timing pulley. Collect slackness of the injection pump timing pulley and camshaft timing pulley with bolts.



OK 1023



OK 1024



- Turn the crankshaft two turns in normal direction of rotation, then turn it further 90 degrees beyond the top dead center. Loosen the tension spring to let the spring take up slackness of the drive belt.
- Tighten the bearing nut to specification.

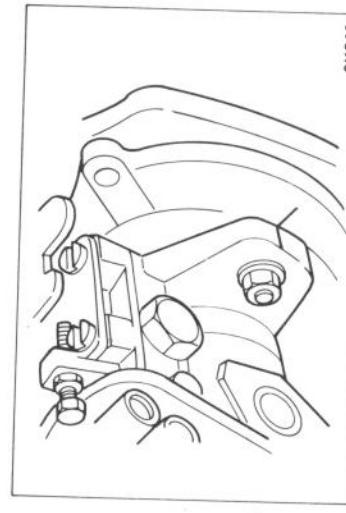
Torque (kg·m)	11 - 13
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5. Flange

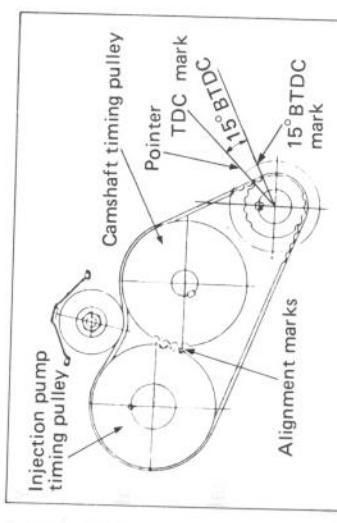
Install the flange by aligning the hole in the outer circumference of the flange with the timing mark "▲" on the injection pump. Turn the crankshaft two turns and check that the timing marks are in alignment.

Timing adjustment

Check that notched line on the injection pump flange is in alignment with notched line on the front plate.



OK 910



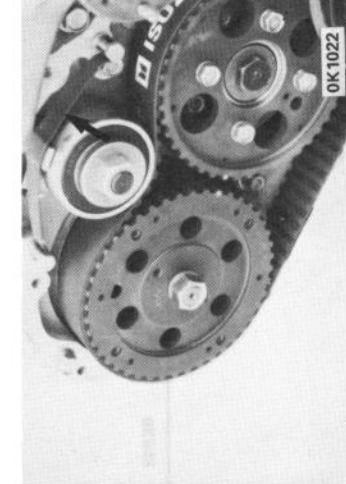
Bring the piston in No. 1 cylinder to top dead center on compression stroke by turning the crankshaft as necessary. With the front upper cover removed, check that timing belt is properly tensioned and that timing marks are aligned.



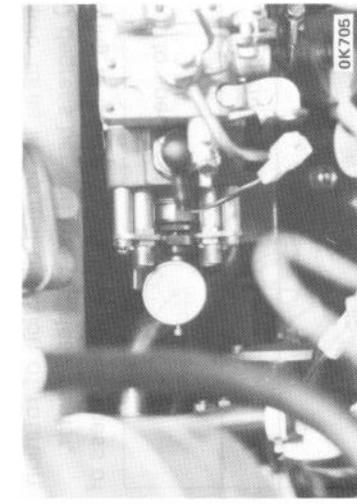
4. Tension spring

Install the tension spring properly. Remove the pulley fixing bolts and set the tension bearing temporarily.

Torque (kg·m)	3 - 5
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OK 1022

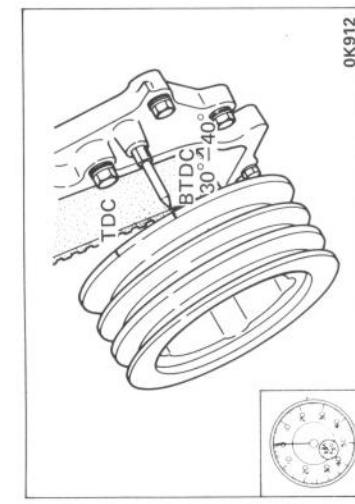


Disconnect the injection pipe from the injection pump and remove the distributor head screw, then install measuring device.



The dial indicator should be installed with the probe depressed inward by approximately 2 mm.

Measuring device



Bring the piston in No. 1 cylinder to a point 30° — 40° before top dead center by turning the crankshaft, then calibrate the dial indicator to zero.



Turn the crankshaft until the line 15° on damper pulley is brought into alignment with the pointer, then take reading of the dial indicator.

Timing	15°
Standard reading (mm)	0.47 — 0.53

Turn the crankshaft in normal direction of rotation.

If the injection timing deviates from the specified range, loosen pump fixing nuts and bracket bolts, then make an adjustment by varying injection pump setting angle.

When larger than standard value:

Turn the injection pump toward the engine so that the dial gauge reads the standard value.

When smaller than standard value:

Turn the injection pump away from the engine so that the dial gauge reads the standard value.

0K979

Reassembly steps

- ▲ 1. Cylinder head gasket
- ▲ 2. Cylinder head
- ▲ 3. Rocker arm shaft assembly
- 4. Water pump

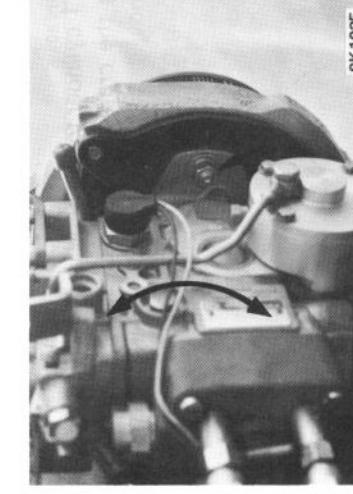
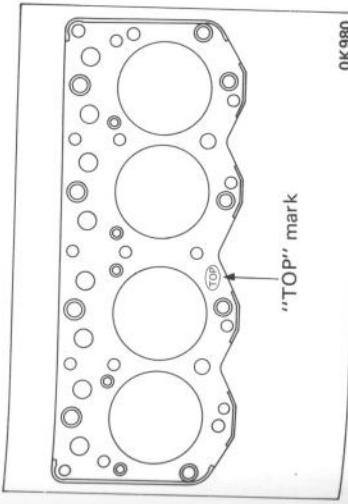
0K979



Important operations

1. Cylinder head gasket

Install gasket with "TOP" mark side up on the cylinder body.



0K1025

 **2. Cylinder head**

Tighten cylinder head bolts in numerical sequence.

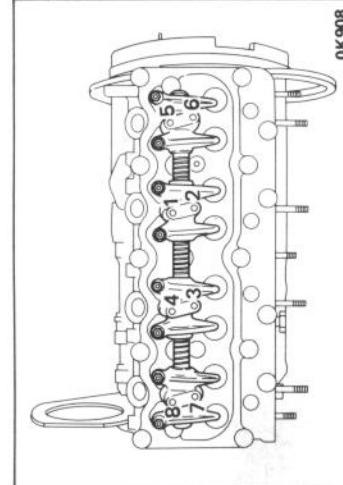
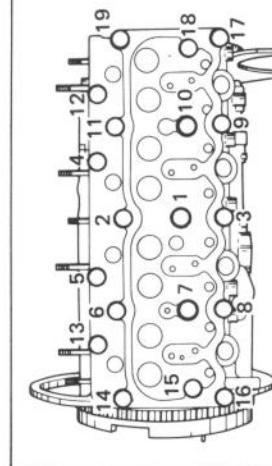
	1st step	2nd step
New bolt	6.5	8.0
Reused bolt	6.5	9.0

 **3. Rocker armshaft assembly**

Tighten rocker armshaft bracket bolts in numerical order.

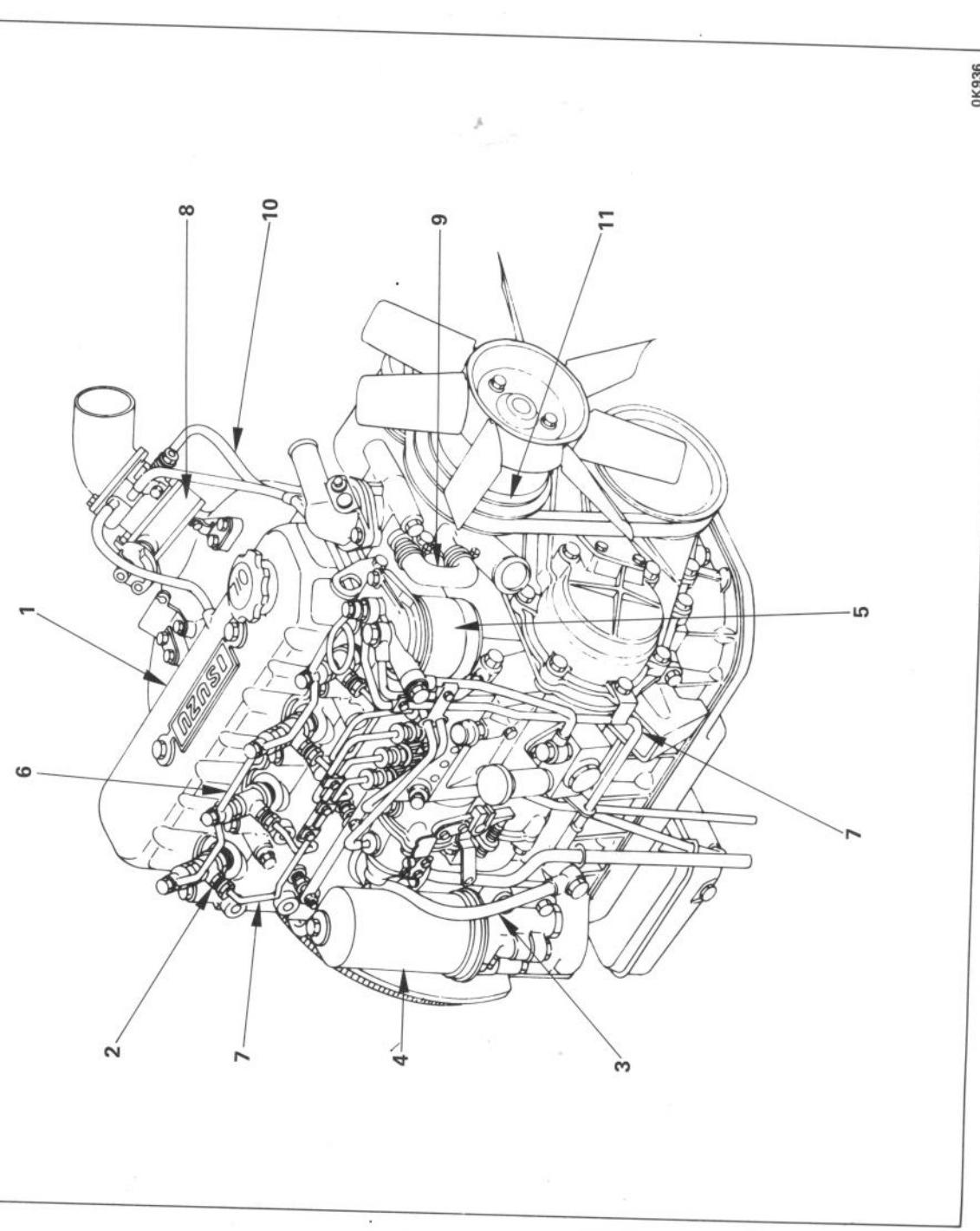
Rocker arm bracket torque (kg-m)	1.3 – 2.3

Adjust the valve clearances referring to page 1-13.



EXTERNAL PARTS (Right hand side)

This illustration is based on the C240 model



0K936

Reassembly steps

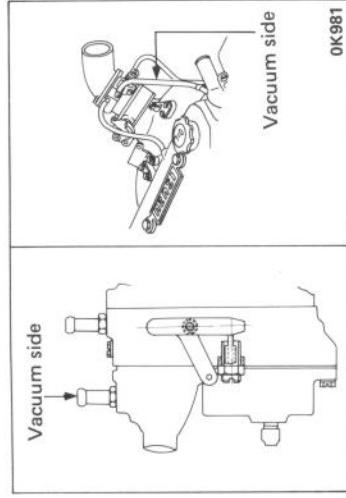
- 1. Cylinder head cover
- 2. Injection nozzle
- 3. Oil pipe : oil gallery to vacuum pump
- 4. Oil filter
- 5. Fuel filter
- 6. Leak off pipe
- 7. Fuel pipe
- 8. Intake shutter and throttle valve
- 9. Water hose
- ▲ 10. Vacuum hose
- 11. Fan pulley

0K936

 **Important operation**

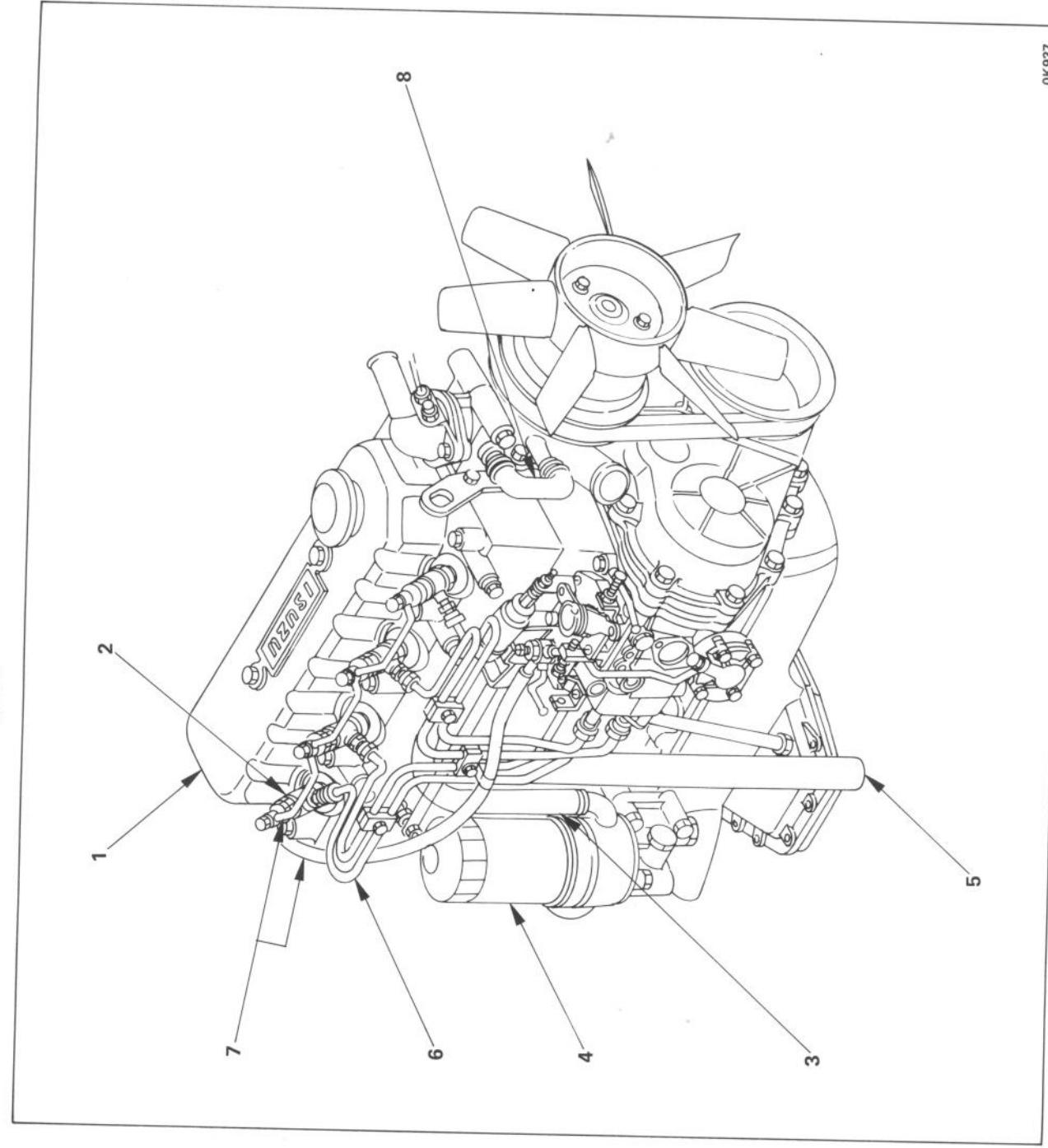
10. Vacuum hose

Connect red colored vinyl hose to the hose joint on the vacuum side.



EXTERNAL PARTS (Right hand side)

This illustration is based on the C190GB model



Reassembly steps

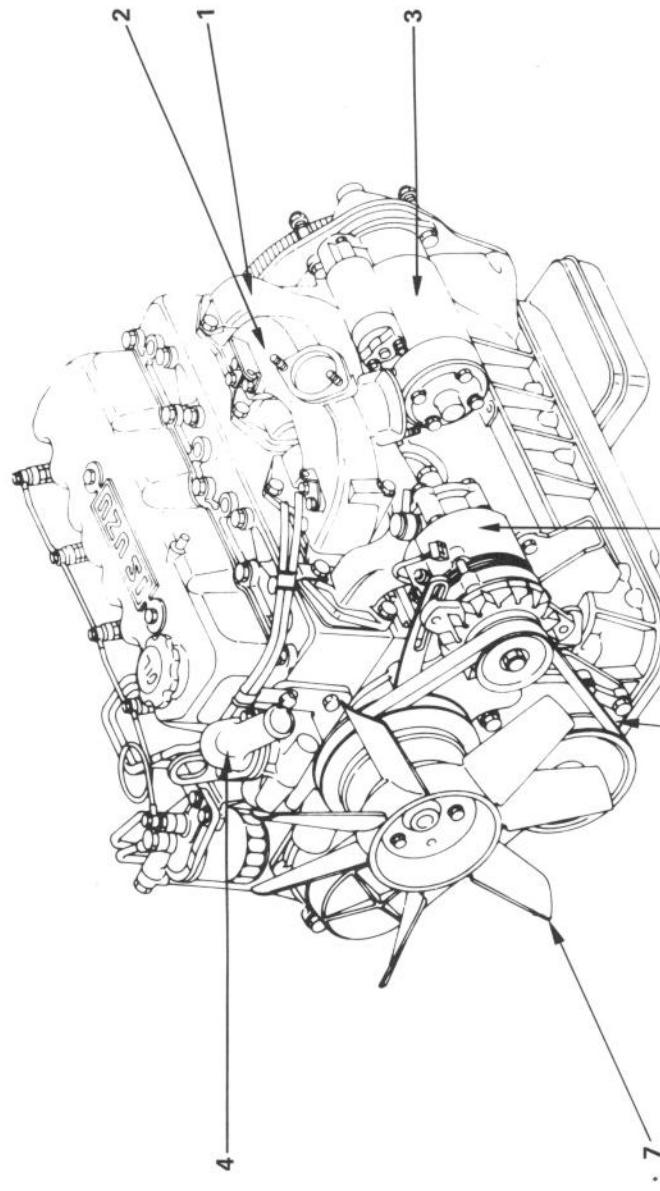
1. Cylinder head cover
2. Injection nozzle
3. Water hose
4. Oil filter assembly
5. Air breather hose
6. Injection pipe
7. Leak off pipe
8. Water hose

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EXTERNAL PARTS (Left hand side)

This illustration is based on the C190 and C240 models.



GENERAL DESCRIPTION

